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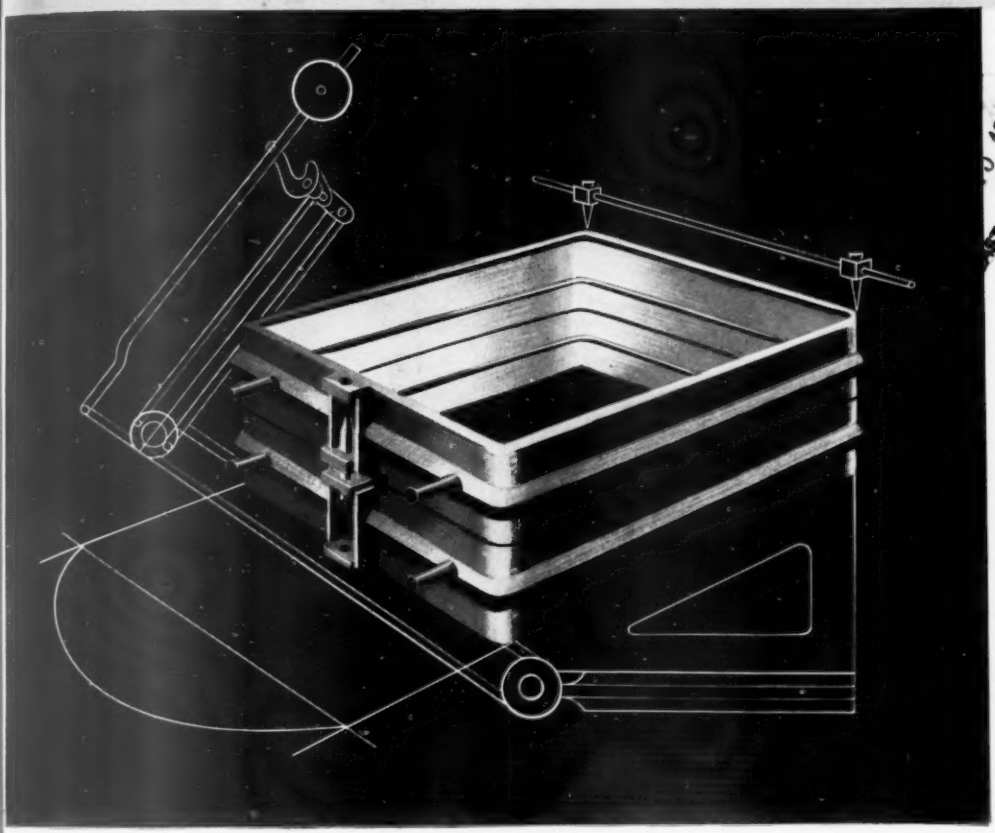

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DSIR

Researches at the British Cast Iron Research Association are helped by grants from the Department of Scientific and Industrial Research, by whom this this notice is issued.

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FOUNDRY TRADE JOURNAL

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What the Figures Show

For the second year running, output statistics show that the founding of copper-base alloys have made the most progress during 1956, with a record production (since the war and the immediate post-war period) of 77,055 tons or 6.9 per cent. improvement. The progress is unquestionably due to the increased interest generated within the industry in technology, following upon the Productivity Report made by a team of experts on their return from America and the help given under the Conditional Aid. Moreover, it has been helped by some trends in marine engineering practice. Whilst the output of steel castings is not a record, the showing is quite good. The highest figure was in 1943, when bomb production was at its peak; the total output was then 365,100 tons. However, last year's production, at 312,142 tons, is the best since 1944 and 6 per cent. better than in 1955.

The ironfounding industry has not quite equalled the 1955 record production. At 3,899,170 tons, it shows a loss of the order of ½ per cent., but the trend during the second half-year was much more marked, for in the last quarter a decrease of 6¼ per cent. was registered. The loss was greatest in the production of automobile castings—about 27 per cent. On the credit side of the picture was a marked increase in the production of castings for railway equipment, which showed a gain of 23 per cent. The labour force, which in December, 1956, was 140,258, has an over-the-year loss of about 4 per cent.

The aluminium founding industry has suffered a setback. The production of 78,564 tons last year shows a decline of 13 per cent. over the previous year's record figure of 90,206 tons. December was a particularly poor month, as only 1,531 tons of sand castings; 2,990 of gravity-die and 1,206 tons of pressure-die-castings were produced. The average monthly output for the previous 11 months was 1,836; 3,561 and 1,224 tons. It will thus be seen that gravity-die-casting suffered about the same percentage reduction as sand casting, and pressure-die-casting but very little. The youngest of the foundry alloys, magnesium, suffered the worst setback of all; from last year's record production of 4,557 tons, there was a sharp decline to 3,384 tons—over 25 per cent. The December output of 192 tons was particularly poor, probably the industry is being affected by the Suez crisis, as much material is used for both tankers and pipe-lines, whilst the slump in the automobile industry has not been without effect. According to some economists, it is the steelfounding industry which best reflects true trade trends as a high proportion of its output goes into capital goods. We hope this is a true appreciation of the situation.

J. W. GARDOM, M.Cons.E., A.M.I.Mech.E., F.I.M.

Principal, John Gardom and Company

Featuring . . . .

JOHN GARDOM

MR. J. W. GARDOM, M.CONS.E., A.M.I.MECH.E., F.I.M., principal of the firm of John Gardom and Company, consulting engineers, was born in 1893 and received his early technical training at the Manchester College of Technology and the Department of Metallurgy of Manchester University as assistant to the late Sir Harold Carpenter. He left Manchester to become assistant chemist in the metallurgical laboratories of the Midland Railway Company, Derby. During world war I, he served in the Royal Artillery but was recalled in 1917 to take up a technical position at the Royal Aircraft Establishment, Farnborough.

After the war, Mr. Gardom was connected with the Skefko Ball Bearing Company, Limited, Luton, at first as assistant metallurgist and later as the chief metallurgist. In 1922, he joined Bagshawe & Company, Limited, Dunstable, as metallurgist, where he became works manager, leaving in 1933 to establish his own business as a consulting engineer, specializing in foundry installations.

During the world war II, his company were responsible for building and operating a number of foundries for the Ministry of Supply and immediately afterwards he advised several of these foundries on conversion back to more peaceful products. His activities as a consulting engineer have extended to the Continent of Europe and he has recently been appointed adviser to a large private company in India, following a procedure which he has adopted in the latter years of becoming adviser to a number of companies in Great Britain.

Mr. Gardom is a member of the Association of Consulting Engineers and has been associated with the Institute of British Foundrymen for some 30 years. He was president of that Institute during the years 1944/6 and received the E. J. Fox, Oliver Stubbs, and British Foundry medals, of the Institute. In 1945/6, he was also president of the Institute of Vitreous Enamellers, of which he is an honorary member and life member of Council. On the formation of a technical committee in this Institute, Mr. Gardom was appointed chairman and still holds this office. He has also been president of the National Trades Technical Society and is the present independent chairman of the National and Midland Ironfounders' Association. Mr. Gardom is a Liveryman of the Worshipful Company of Founders and a Freeman of the City of London.

Although he has led a full and mobile life, Mr. Gardom has been an active sportsman; in recent years, however, these activities have had to be curtailed.

Correspondence

INTERNATIONAL COMMITTEE OF FOUNDRY TECHNICAL ASSOCIATIONS

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—We have noted with interest the item in the "Personal" column on p. 153 of your January 31 issue, stating that Mr. Hallett has replaced Mr. V. C. Faulkner as the British representative on the International Committee. In view of recent changes in the construction of the Committee, we feel that some clarification of your announcement is required.

The rules now in force for the International Committee, as amended at Düsseldorf last year, allow for two official delegates to be appointed by each constituent association and it is recommended that at least one delegate shall be elected for a minimum period of two years in order to ensure continuity. In the Institute of British Foundrymen, the two delegates to the meeting of the International Committee are appointed each year by the Council, and traditionally, one of the delegates is the president of the Institute, if he is attending the International Congress, if not, a senior officer of the Institute acts in his place. We are all delighted that this year Mr. M. M. Hallett has agreed to act as the second delegate, in the thought that he will continue as delegate for some time to come, thus meeting the desire for continuity. He is, however, subject to re-election by the Council each year.

At the last meeting of the International Committee in Düsseldorf, the status of past-presidents of the Committee was clarified and they are now permanent members of the Committee as long as the constituent association is affiliated to the International Committee. Mr. Faulkner, as a past-president of the Committee, is a permanent member and there is no question of his resignation or replacement. In any case, we are all glad that in view of Mr. Faulkner's long service both to the International Committee and the IBF, he has a continuing place on the Committee. We might also point out that, under the rules, both Mr. V. Delport, and the president for this year are permanent members, so that the IBF is well represented.

A. B. EVEREST,
President.
G. LAMBERT,
Secretary.

International Committee Foundry
Technical Associations
February 20, 1957.

ADVANTAGES OF CAST PARTS

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—The writer was interested to read the article appearing in your issue of February 14 (page 203) on the advantages of cast parts, and particularly to see the illustration of the bridge at Coalbrookdale, commonly referred to as being at Ironbridge. Although it was interesting to know that this was constructed entirely of cast iron, your readers might be more interested to know of its amazing resistance to corrosion, which the writer thinks is the most remarkable thing about the bridge. He examined the bridge a year or two ago and found it very difficult to believe that it had not been treated with some corrosion-resisting process. However, apparently it has not been so treated, or at least, there is no sign of any treatment, and it appears that the cast iron has built up its own resistant surface. It is a hard surface with no signs of scale, or rust, as it is commonly recognized. Not being a metallurgist, the writer could not, of course, put forward any theory, and yet the surface to-day is truly remarkable.

This appears to be one of the very great advantages of cast iron, but it may be that this characteristic only applies to the particular type of cast iron from which that bridge was made. The subject is so interesting that the writer thought it might be quite well worth your while to enlarge upon it at some time. Is it that in those days they could make iron, which, from a corrosion resistance point of view, was vastly superior to anything that is produced to-day?

A. W. BENN,
Sales Development Manager.

Charles Winn & Company, Limited,
Granville Street, Birmingham, 1.
February 20, 1957.

Air Pollution by Industry

A conference on "The Mechanical Engineer's Contribution to Clean Air" was held in London from February 19 to 21 by the Institution of Mechanical Engineers. Altogether 19 papers were delivered, dealing with smokeless combustion of coal or oil in large boilers, SO_2 removal from flue gas, electrostatic precipitators, mechanical grit and dust collectors, and other means of preventing grit, dust, and smoke emission from boilers. Road vehicles, particularly diesel trucks, were discussed in four papers, and other papers dealt with the cement, ceramic and chemical industries, locomotives, ships in port, boiler instruments and automatic control, education and training of boiler operators.

Two papers of greater interest to readers of this JOURNAL were:—"Dust Problems of the Iron and Steel Industry," by M. W. Thring and R. J. Sarjant; and "Foundry Atmospheres," by W. B. Lawrie. It is intended to report the conference more fully in future issues of the JOURNAL.

International Foundry Congress in Sweden

In the programme of this year's International Foundry Congress (Stockholm, August 19 to 23), printed in last week's issue of this JOURNAL, it was made clear that registration could be made direct to the Swedish organizers or to local secretaries who are arranging block bookings. For those attending from the United Kingdom, it is now pointed out that hotel accommodation has been allocated through the secretary of the Institute of British Foundrymen (Mr. G. Lambert, St. John Street Chambers, Deansgate, Manchester, 3). Intending participants from this country are therefore advised to inform Mr. Lambert of their requirements. Accommodation in Stockholm is expected to be very severely taxed during the Congress period and early application is most advisable.

Business as Usual

Smith & McGowan, brassfounders and coppersmiths, of Citadel Foundry, Commercial Street, Leith, Edinburgh, 6, state that following the fire which completely destroyed their foundry, they have secured temporary premises, and are now in full production. However, as the machine shop is intact all communications should still be addressed to Commercial Street.

Fifty Years of Art Founding

By A. L. Parrott

The Author begins by referring to the development in casting processes since art-founding was practised first in the pre-Christian era. The two main methods, wax- and sand-moulding, are next outlined. Thereafter, Mr. Parrott commences his reminiscences of art founders, sculptors and models and so picks out the "highlights" of years of happy experience in the industry. First, he tells of his apprenticeship and early training and soon continues with accounts of particular jobs tackled. Amongst the notable jobs which he describes from his unique personal knowledge are the Rhodes and Landseer lions, the Scales of Justice on the Old Bailey, "The Roosevelt" in Grosvenor Square, "Eros" in Piccadilly, and the George V statue. Of more recent work, particulars are quoted of Epstein's "Social Consciousness" group and his "Les Majestas" (the latter in aluminium); the statue of Ceylon's Prime Minister, the "Lady with Thread" and a commemoratory plaque.

Modern example of the art of bronze-statue founding—the King George VI memorial statue standing in Carlton House Terrace, London. The work of William McMillan, K.B.E., R.A., this figure was cast by the Author's firm; it stands 9-ft. 6-in. high.

Before dealing with the detail of jobs tackled at the art foundry—Morris Singer Company, Limited—with which the Author is associated, it is necessary briefly to describe the existing set-up and the main founding processes involved. The crafts practised at the Morris Singer concern (in South Lambeth, London) have been handed down from skilled workers trained at the art foundries of J. W. Singer & Sons, Limited, in Frome, Somerset, and the Morris Art Foundry, London. Art founding as a craft probably goes back longer than any other type of founding, even to before castings were made for utilitarian purposes, yet the processes of moulding to-day for art castings in bronze and precious metals vary very little from those of centuries B.C. Two main methods are employed: the *cire perdue*, or lost-wax process, and the sand process, these being briefly outlined in the paragraphs which follow.

Cire Perdue or Lost-wax Process

In commercial art-casting, first of all, the sculptor in collaboration with the architect, produces a design and sketch model of the job commissioned. This is submitted for approval of his client or the committee sponsoring the work. Following approval of the sketch and possibly a small-scale model, the sculptor creates the full-size model in clay, a plaster cast is made and sent to the foundry to be moulded by one or other of the processes mentioned; work of medium size may be cast in one piece by the wax method.

The lost-wax method is undoubtedly the oldest way of making a casting, the earliest mention in the Bible being of Aaron making a golden calf. However, the Chinese understood this craft possibly 3,000 years before the Christian era. The ancient method was to prepare a core of clay mixed with dung and made into a shape as neatly as possible to set hard; when quite firm, a layer of beeswax would be built or fashioned in some way over the hard core. The wax, being soft, could be easily modelled into shape and a delicate texture could be brought out by the artist until he was quite satisfied with the form seen before him. An addition was next made of sticks of wax or feeders which were attached to the wax model on the one side in addition to smaller feeders or wax attached to the lower parts on the opposite side. The wax model was then ready for the mould to be made. A preparation of muddy clay was next applied,

The Author:

Mr. A. L. Parrott for the past 15 years has been foundry manager of the Morris Singer Company, Limited, the well-known London art foundry. He was apprenticed with J. W. Singer & Sons, Limited, of Frome, Somerset, in 1904 and when his apprenticeship ended had experience in the Midlands at Elkington's in Birmingham, at the Bromsgrove Guild and with Rolls-Royce, Derby. In 1922 he rejoined his old firm which had moved to London and amalgamated with the Morris Art Foundry of South Lambeth.

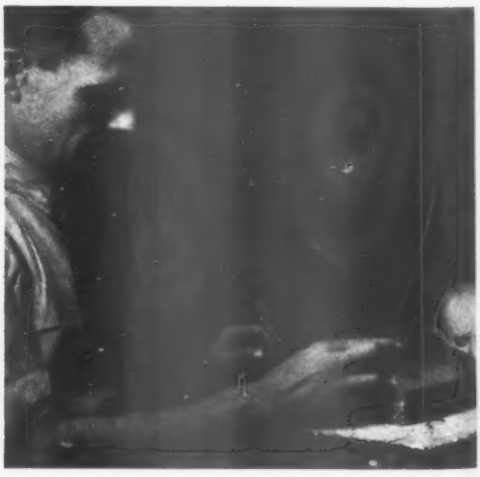
FIG. 1.—*Thicknesses of clay being placed on the surface of a plaster model in the "wax" process. The same thickness can be reproduced in gelatine and, subsequently, a wax replica of the model is "cast." Given the "wax" pattern, the process of casting is similar to normal investment techniques—the pattern is moulded in a special refractory; the wax melted out; the mould is fired, and finally set up for pouring.*

FIG. 2.—*Further stages in the "wax" process as practised to-day: (a) (below) cutting the core and (b) (right) fixing wax feeders and ingates in position preparatory to moulding.*

building up in layers as the clay set, until the mould was ready to be baked. A fire was then lighted around the mould and gradually the wax melted out, leaving a space between the outer mould and the inside core. When all the moisture was baked out of the mould, it was set-up for casting, the molten metal being poured into the space *via* runners and feeders also formed by the melting out of the wax. As soon as the metal set, the clay was broken away, leaving a replica of the wax model, plus the channels or feeders attached to the casting. These would be trimmed off and any imperfections touched up until a satisfactory result was obtained. Then, the clay core was tapped out, leaving the casting hollow.

Present-day Method

The present-day method of lost-wax casting (Figs. 1 and 2) is much about the same, except that the sculptor supplies a plaster model to the bronze founder, who makes a gelatine mould, first using clay sections over the model. The gelatine, being flexible, can afterwards be pulled away from the mould, retaining an impression of every detail in the negative. The gelatine mould portions are assembled, with armatures stretched across at intervals; then a mixture of brickdust and plaster of Paris is poured in, and withdrawn when set. A layer is next pared off which represents the thickness of metal; the pared core is replaced in the gelatine mould, suspended on the armatures, the mould is closed and liquid beeswax is poured in, the result being a wax model as was produced by the ancient method. Some artists like to retouch the wax model, and sign their names in the wax —the late Sir Hamo Thornycroft used to sign his work with a finger- or thumb-print which would come out in the casting, and there could be no question subsequently but that a statue bearing his thumb-print was genuinely this sculptor's work.



Sand Process

In the so-called sand process, the material used obviously is not flexible, like gelatine, and so means of tackling various jobs and particularly undercuts have to be thought out carefully and systematically well in advance. To do so, one must visualize the work from its commencement right down to the finishing stages before any start is made. The sand the Author uses is a rich loamy greenish-yellow sand which is purchased from Westbury in Wiltshire, not far from his native town. It is prepared by drying and passing through a very fine sieve, water is then sprinkled on it, and after mixing and blending thoroughly, it is put through a mill with steel rollers, like an upright mangle, which sends the sand through in stiff flakes. The sand is allowed to stand for two to three days and then milled once more, when it is ready for the moulder to use. One can see what a very complicated job moulding a statue by the sand process can be when the model is full of folds and sharp undercut hollows, as shown in Fig. 3. The mould of a full-size or above life-size statue usually consists of a top and bottom mould, with side moulds to take the contour of the figure. In each undercut portion, a series of tiny moulds or "drawbacks" has to be made, until it is possible to take an impression which will lift clear of that section of the plaster model, taking in all the fittings or "prints" of the drawbacks, so that each one can be replaced in its proper position later, to make a faithful reproduction of the artist's work.

When all sections of the mould have been taken from the plaster model (Fig. 4), the model is released, and the mould reassembled. Armatures of steel are suspended across the mould—a framework of iron being made to take the shape of the inside—

FIG. 3.—*Preparation of sand pieces for the moulding of a life-size model; note the insertion of loose "drawbacks."*

FIG. 4.—*Piece moulding in sand reinforced with plaster of Paris. The mould is for the King George V memorial statue at Canberra, shown completed in Fig. 7. The use of a tallow core with an iron frame for a "tricky" section is clearly shown.*

and tied firmly to the armatures to support the core. The mould is then covered with tissue paper to preserve it, and fine core-sand is firmly rammed into it until once again a replica of the model appears in sand, supported by the armatures. The sand is next pared off by a thickness varying from $\frac{1}{4}$ in. for a small statuette to $\frac{1}{2}$ in. or $\frac{3}{4}$ in. for a colossal statue. This will leave a space between the inside and the outside of the mould, which will eventually be filled with the molten bronze. Statuary is not carved out of solid metal as some people imagine!

Drying, Re-assembly and Casting

All parts of mould and core must be thoroughly dried. When dry, the various parts are closed together in their registering fittings, leaving open various channels to allow for the flow of metal. A large basin is placed over these channels which are brought to one pouring point. Finally, the mould is bolted together, as the pressure of the molten metal is very considerable. The metal (usually bronze) is melted in furnaces, tilted into a ladle, the dross skimmed off, and when ready, poured into the basin mentioned. Other channels having been previously prepared in the mould for the escape of gases, and to allow free passage of air to be driven from the mould. When the founders see the molten metal forced up these channels they know the mould is filled.

Fifty Years of Art Founding

Soon after pouring, everything must be loosened to allow the casting to contract without imposing shrinkage stresses which might lead to fracture. When cool, the mould is broken away and the casting released. The runner channels are still attached to the casting, and these have to be cut off with hacksaws and chisels, or (in recent times) by portable machine saws.

Finishing

The finisher's job is to imitate the body texture where the channels have been attached to the casting, and to repair the holes left when the steel armatures are removed, so as to free the core. The casting is thoroughly cleaned and subsequently coloured, using various acids to obtain the patina required. All contracts are completed to the entire satisfaction of the sculptor who spends quite a time in the foundry explaining his or her ideas, or even makes an opportunity to alter or touch-up his own side of the work.

In this introduction the Author has endeavoured to give a brief explanation of the practical part of his job, without going into the other half, namely estimating, supervision and instruction which are very important duties in such a foundry. Looking back one often wonders whether one would choose the same occupation again, or go in for one of the "safer" jobs. However, there is a certain measure of satisfaction about it, so that when an art founder comes across his work in various parts of this country and abroad, and sees the part the foundry plays in putting the work of Old Masters into perm-

FIG. 6.—*After a "spring clean" of Eros in Piccadilly Circus, London, workmen from the art foundry are shown reassembling the support and sealing the joints to render them watertight.*

FIG. 5.—*Mr. F. Mancini, F.R.B.S., the famous sculptor, adding finishing touches to a model of the head of a Chinese gentleman.*

anent form, he may well feel content that the work will last long after he is forgotten, and on reflection feel he might have done much worse than be an art bronze founder.

Fifty Years' Practice

It is not proposed to give any further discourse, explaining the art of bronze-statuary founding, but instead the Author's own story of the different phases of his career during the 52 years in which he has engaged in this work is given in his own words:

His first acquaintance with statuary founding was when as a boy of nine he watched a procession in Frome to commemorate the Diamond Jubilee of Queen Victoria (before the age of motor transport) and was fascinated by a team of five horses trying to pull the bronze casting of one of the horses of the Boadicea group, up the steep incline leading from the centre of the town. This world-famous statuary group is now erected on the Westminster Bridge side of the Thames Embankment. On a wagon in the same procession, one of the casters

from the J. W. Singer & Sons foundry was busy pouring molten zinc into a steel die carrying an impression of Her Majesty, to produce medallions. The die was mounted on a platform fixed to the conveyance and as fast as the medals were poured, down came a guillotine to cut off the runners. The medals slid down a chute at the back of the wagon, the natives of Frome burning their hands scrambling for them as souvenirs.

After spending a few more years learning the "three R's" at the Blue Coat School, the idea of the headmaster was to take the Author as an articled pupil, with a view to training him as a day-school teacher. His father, however, like the majority of fathers in those days, thought that he should have a "trade in his hands," remarking that this was one of the things that no-one could take away. There being no vacancy in the drawing office, he was told that the bronze-statuary founding was the next best job, and after three months trial, was made an indentured apprentice for 6½ years. The apprenticeship rates for the first 12 months were 3s. per week, for the second 12 months 4s. and so on up to the last year, when he was paid the princely sum of 9s. per week—at the age of 20.

Early Experiences

After getting acquainted with the various craftsmen in the foundry (about 40 in all), and becoming "acclimatized" to the type of sand to be used, the sulphurous atmosphere, etc., running errands for the men, going to the stores for the dose of "strap oil," and the local stables at the hotel for the manure to make loam cores, one can safely say that he learned the hard way.

The craftsmen were either the sons of Belgian, French or Swiss craftsmen, or the older foreign craftsmen themselves. These men had been brought to Frome by the founders of the firm, John Webb Singer, in response to the persuasion of the leading sculptors of the day, among them Alfred Drury, R.A., Onslow Ford, R.A., and Sir Hamo Thornycroft, R.A. In turn they taught the natives of the town to carry out this special work of bronze founding and the Author formed part of the second generation after the settling of these craftsmen in England.

From the very first day he entered the foundry, he was allowed to make a mould and well remembers the first job was a cornice to fit on the bottom of a small pillar for the counter rail of a bank. After a week's practice, he was allowed to pour molten bronze into a mould he had made, have it fettled, and proudly take the casting home with pride for his father to see.

In those early days, art-foundry work was varied and interesting. The statue of Gladstone, together with the main groups at the base of the statue were being cast, and to keep his interest from flagging, the Author, then a boy of 15, was allowed to try and make some of the smaller parts of the groups, such as the short sword, and the heads of the snakes, etc.

FIG. 7.—*King George V memorial statue for Canberra (14-ft. 6-in. high) receiving the finishing touches in the South Lambeth Foundry.*

The next important job that came his way was the casting of the sword and scales of the huge gilded figure of Justice since erected on the top of the Old Bailey. This statue has a steel core inside of approximately 2 in. by ¼ in. thick, built into the arm supporting the scales and terminating in the main armature built into the corner of the building. From time to time, readers will no doubt have seen photographs in newspapers of workmen perched precariously on this arm, carrying out the usual three-yearly maintenance. In fact, the last time the figure was re-gilded, a craftsman with a lively imagination told John Ellison in one of his "In Town To-night" BBC programmes, that he had a very narrow escape when he sat in the scales and was weighed down 3 in. He may have felt that the scales swung over in his direction, but in actual fact they are quite rigid.

Lion Castings

The next contract was the casting in bronze of the Cecil Rhodes memorial for South Africa. This consisted of a large figure of Cecil Rhodes and eight lions, each slightly smaller than the famous Landseer lions in Trafalgar Square, and strange to say were modelled by another painter, by the name of Swan. He used to visit the zoo to observe the

movement of the lions in their cages, and would very often stay there all day just to observe the flicker of an eyelash; sometimes he would come back to the studio in the evening with only one line drawn, showing the top or bottom eyelid, which he would transfer to the rough clay model.

Castings for the eight lions were made from one model and after the first four had been cast, Mr. Mancini—the father of the celebrated sculptor, Mr. F. Mancini—came to Frome. Here, he cut off the tail of the plaster model, and re-modelled it so that it would be on the opposite side of the first four lions, to make the group balance—their tails on the right and left hand respectively. (Mr. F. Mancini, who is known for his statue of Queen Elizabeth on horseback—part of the Coronation decorations for Selfridges—is shown working on a plaster "head" in Fig. 5.)

The method of moulding the lions in the first instance was to cast the tails separately and make the remainder of the lion all in one piece, with the front and back paws cast on to the main job. A moulding box was constructed for taking the whole of the body of the lion with an outside box section to contain the head. The two halves of the mould, front and back, together with the side pieces or drawbacks, were made successfully in this manner until the time came to turn the mould over. During the turning process, the head part of the mould was hanging down into the pit which had been dug out of the floor in the foundry to accommodate it. Unfortunately, the weight of the two halves of the head mould caused the main mould structure to strain and sag, and in the final turning-over, the whole of the mould began to break up, the cast-iron parts of the moulding-box flying in all directions.

Revised Method

A conference was held in the foundry, and it was decided to construct the moulds upright, the model standing on its own base, the mould then being in two main sections. Huge frames were constructed, supported on bronze shoes, which dovetailed into the base of the mould, the frames being filled with plaster of Paris to support a 2-in. thickness of sand constituting the face of the mould and with an outside shaft to keep these sectional moulds in position. When one set of the sectional moulds were taken away, the model could be released for the commencement of the construction of the next mould.

It was normal for an older and experienced moulder to be in charge of such work, with a younger man helping him, and the Author in his early years with the firm was the youth who made up the trio. The work on the lion group lasted nearly two years, and by the time the eighth was in full swing, he had acquired a good working knowledge of how to make a lion of such dimensions. One other incident occurred during the pouring of the molten bronze into the first mould—there again the lion's head was the troublesome feature. It was decided to pour the main part of the lion's body from a 3-ton ladle, leaving the filling up of the lion's head through a separate runner to be completed from a 600-lb. pot man-handled by six people. Unfortunately, when the word was given to pour, the six men were unable to get to their runner before the main ladle had started to deliver its contents. The result was that the displacement of air by the main flow of metal made it impossible for the six men to deposit their part of the charge, and as fast as they tried to pour the metal, so the molten bronze was being blown up to the roof of the foundry. Luckily no-one was hurt, and the casting turned out to be a success. The remainder of the lions were poured from the main ingate only, with ample risers—instead of runners—from the top of the head.

FIG. 8.—*Sir Jacob Epstein's Group of five figures entitled "Social Consciousness" standing in Fairmount Park, Virginia, USA.*

Nelson's Lions

Looking at the Landseer lions at the foot of the Nelson monument in Trafalgar Square, London, one can detect a similarity of the method of pro-

duction to the lions on the Rhodes monument; the only difference with Landseer lions is that no plaster of Paris was used to reinforce the various parts of the mould, and no moulding box was employed, until the final pouring of the bronze. The mould appears to have been made around the model in a series of block pieces or drawbacks, each approximately 2-ft. long by just over 1-ft. high, and were fashioned about the model, each one being so cut as to stand one on top of the other to form the mould of the outside of the lions.

To make the core, these sand pieces were reassembled on the sand bed, and the core rammed up to them until a replica of the model of the lion was produced in sand. The sand pieces were then withdrawn and each section of the core was pared down by $\frac{1}{8}$-in. thickness until the whole of the body of the core had been so reduced all over its surface. The core was then dried *in situ* and each sand piece (properly numbered) was also put into the oven and dried. When the mould was reassembled for casting, a moulding box was made up to enclose the whole to prevent strain during the actual pouring, and the main joints in between the sand pieces were made good.

When the assembly and closing operations were completed, the molten bronze was melted in the various furnaces and brought to the pouring point—

FIG. 9.—*"Prime Minister of Ceylon":—a* 13-*ft. bronze produced from a sculpture by James Woodford, O.B.E., R.A.* (*the sculptor of the "Queen's Beasts."*).

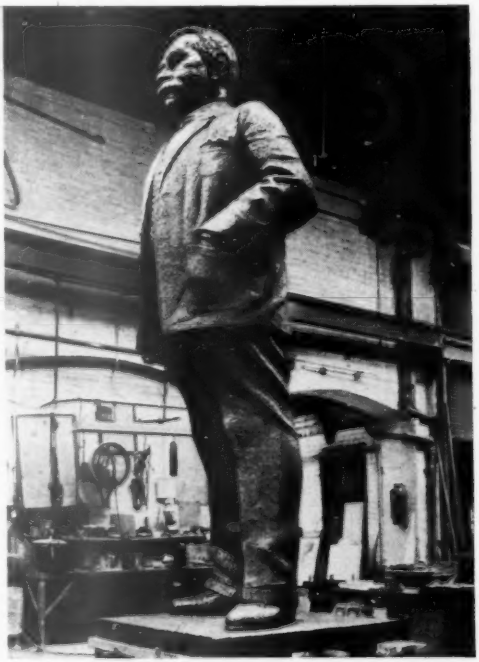


FIG. 10.—*Plaster casts of the legs and torso used for the production of the Prime Minister of Ceylon statue. The torso was made in two parts and* (*later*) *the legs were divided for convenience in founding.*

the latter being an iron basin lined with sand and partially dried, so that the metal was not chilled in the process of casting. A plug was inserted in the centre of the basin; about $\frac{1}{2}$ ton of bronze was poured into it; the plug was lifted and the caster kept up the pouring pressure until he saw metal in the risers.

Post-apprenticeship Period

Soon after his apprenticeship was completed, the Author had experience in the Midlands. This consisted of a few weeks at Elkington's of Birmingham, makers of fine bronze and silver castings, and a period with the Bromsgrove Guild, who designed and executed the Buckingham Palace gates —at this time, several of their best craftsmen were sent to America to work, but unfortunately they perished in the Titanic disaster. After 14 months' experience at the Guild, he returned to the old firm in Somerset, where he found the additional experience acquired served well, and at 24 he was able successfully to mould and cast a horse's body, one-and-a-quarter times life-size.

The 1914-18 war came, and in 1916 some of the Frome art-founders found themselves drafted to Derby as War Munition Volunteers, Winston Churchill being the Minister of Munitions at that time. Here, the Author had his first experience of strong trade unionism, individuality having to take a back seat to mass opinion.

On returning to the old firm in 1918, a feature of the post-war period was that numerous enquiries and orders were in hand for war memorials, plaques and monuments. This resulted in a few good ones being erected, but unfortunately, also, in a large number of bad or rather indifferent ones, which can be seen around the country. After the 1939-45 war, the various memorial committees, profiting no doubt from earlier mistakes, managed

to put up some good schemes. In fact every aspect of the problems was considered, including even such things as the right-of-way of fast-moving modern traffic around the memorial sites.

Recent Commissions

An account of all the art foundry work carried out since the Author came to London in 1921 would make boring reading, but the list includes a few notable jobs, such as the Roosevelt Statue in Grosvenor Square from a sculpture by Sir William Reid Dick, K.C.V.O., R.A.* The installation of the bronze fountains in Trafalgar Square, and the restoration of the Shaftesbury Memorial surmounted by the famous aluminium statue of Eros (Fig. 6), may be worth mention. Other work included the George V memorial statue (Fig. 7) and Sir Jacob Epstein's group "Social Consciousness" (Fig. 8). Only last year, the Author and his colleagues completed a statue in aluminium by Sir Jacob Epstein, called "*Les Majestas,*" or "Christ ascending in Glory,"† which is of very large dimensions, being 18 ft. high. This will be fixed on the organ gallery at Llandaff Cathedral when the building work is completed.

One of the latest bronze statues to be finished is a 13-ft. statue of the Prime Minister of Ceylon, recently sent to that country for erection. The statue (Figs. 9 and 10), by James Woodford, O.B.E., R.A., the sculptor of the Queen's Beasts (made for the Coronation), was first modelled in clay in the form of a small sketch, and from this accurate measurements were taken, armatures fixed up, and

* See "Art Foundry Practice," by A. C. Wizard. FOUNDRY TRADE JOURNAL, April 28, 1949.

† See JOURNAL, October 11, 1956, page 421.

FIG. 11.—*Workmen chipping the case of "Old Man History," for which a plaster "negative" was sent from New Zealand to the London art foundry.*

FIG. 12.—*"Lady with Thread"—companion figure in bronze to that of Fig.* 11. *Standing 9-ft. high, it shows the detailed work possible in this medium.*

FIG. 13 (*below*).—*Art-bronze plaque in the finishing section of the Author's foundry, where the requirements of this class of work are being explained to visitors.* (*Designed by T. Carter Preston, the plaque was destined for Uganda.*)

the full-size model made up in clay. After approval, the plaster mould was made around the clay, and when the clay had been cleaned away from the plaster mould (such as is shown in Fig. 11) a plaster cast was taken from it. The finished plaster model was brought to the foundry in the following sections (Fig. 10): (*a*) the two legs on the base, (*b*) the bust with the two arms attached, (*c*) the torso and (*d*) the head. The head was made by the wax method, and the remainder of the work by the sand method. At a late stage, the founders decided to split the model of the legs at the fork, and cut the base through the middle, as they found that if made as illustrated the mould would be too bulky and dangerous to allow for successful turning over. All the pieces were cast in bronze, later to be carefully fitted together by means of bronze threaded pins, the joints being successfully concealed and coloured to the sculptor's approval. The whole of the bronze statue was sent away in one piece, packed in a strong case, and delivered with the main sling attached ready to lift upright out of the case, and fixed into specially prepared holes, for grouting the ragbolts previously screwed into the base of the figure ready for fixing.

Fig. 12 shows a seated figure in bronze 9 ft. high, known as "The Lady with the Thread." By Frances Shurrock, it forms a companion figure to "Old Man History"; both were erected in Dunedin, New Zealand, to commemorate the Centennial Celebrations, 1848-1948. The final illustration, Fig. 13, is of a commemoratory plaque prepared at the Author's foundry to commemorate the exploits of the British Protectorate of Somaliland's Defence Force, 1940-41. The delicate chasing which follows the casting of such a work is being explained to a group of visiting foundrymen by one of the firm's experts in such work.

Concluding Remarks

If asked for his present views on foundry practice, generally, following his 50 years on the "art" side, the Author would agree with the views of other foundrymen about the necessity for pre-planning, re-design and, to a lesser degree, re-organization of foundries, but cannot see that complete-automatic working of itself can put the vast UK foundry industry on its feet. There is still a great need for foundrymen with individuality of action, thought and main purpose, first to give attention to the means of producing better castings, to encourage clear thinking among the men of the industry themselves, and secondly, to apply special skill to the development of machinery for producing—on a mass-production basis—castings at moderate cost, to provide employment for the workpeople who either do not want to think, or who have the "push-button" type of mind.

Proposed New Foundry

Last week, Mr. J. H. Jolly, chairman of Guest, Keen Iron & Steel Company, Limited, announced it was proposed to construct, at the Dowlais works, in South Wales, an ingot-mould and general castings foundry, a brass foundry and other shops. The capital cost is estimated at £1,708,600 and the work will occupy two years approximately. The following plant has been scheduled at a total outlay approaching £600,000:—

Triple weigh-bridge.
Two portable 7-ton limestone bunkers.
Twenty-ton coke bunker and 80-ft. long belt conveyor.
Twelve cupola-charging buckets.
Weighing car and track.
Three cupolas, 96-in. dia. inside lining.
Three ladles, each of 25 tons capacity.
Three ladle dryers.
Cupola-slag granulation plant.
Sand plant.
Sand-slinging plant.
Four drying ovens, bogies and drag chain conveyors.
Small core-drying oven.
Hydroblast equipment, including bogies and track.
Seven electric overhead gantry cranes.
Alteration and transfer of existing electric overhead gantry crane.
Transfer track for drying-oven bogies.
Transfer system for tackle return.
Three blacking containers with agitators.
Fuel-oil tanks for 20,000-gal., pumps and pipelines.
Air compressor (600 cub. ft. per min. at 100 lb. per sq. in.) with air service pipelines.
Two core-bar extractors.
Lifting tackle.
Stock bins for pig-iron and iron and steel scrap.
Process water system, including settlement tanks.
Labour and equipment for plant installation.
Foundry tackle.

A further sum of about £90,000 is to be spent on electrical equipment for the new foundry.

METAL BOX COMPANY, LIMITED—Mr. K. D. Brough, Mr. D. B. Huffam, Mr. A. W. Page, and Mr. C. E. Sutton have been appointed additional directors.

Foundry Workers' Claim for Higher Differentials

The Industrial Disputes Tribunal has made an award on a dispute between members of associations federated with the Engineering & Allied Employers' National Federation and members of the founding unions affiliated to the Confederation of Shipbuilding & Engineering Unions. The dispute arose out of a claim made by the workers for an increase in the differentials paid under an agreement of February 21, 1946, on the ground that the differentials had not been maintained. It was also stated that employment in foundries, which called for considerable skill, was the least popular department in the engineering industry, and that although the apprentice intake had improved the number of craftsmen employed had constantly declined.

The employers stated that standard of wages in engineering foundries had shown continuous and substantial improvements and that the claim that differentials should increase proportionately with increases in wages was not warranted. Any such increases granted in the foundry section of the engineering industry might well lead to the submission of similar claims from other sections of the industry, not because of merit, but in an endeavour to obtain similar concessions.

The Tribunal awarded that the existing differentials, of whatever the amount, at present paid to skilled moulders and skilled coremakers and foundry labourers shall be increased by 4s. a week for the moulders and coremakers and by 2s. 6d. a week for the labourers. This establishes new base rates to be used for all purposes in the same manner as the existing base rates. Consequential increases in the differentials paid to the intermediate grades of foundry workers were referred back to the parties for settlement. The award is effective as from the beginning of the first full pay period after February 7.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

765,494. Société D'Inventions Aéronautiques et Mécaniques S.I.A.M. 1, Route des Alpes, Fribourg, Switzerland.

Binary alloys of magnesium and rare-earth metals. The content of the latter being from 2 to 6 per cent. The rare earths have the following composition: neodymium 60 to 70, praseodymium 10 to 15, samarium 16 to 17, lanthanum 5 to 15, cerium 0 per cent.

765,747. Allied Chemical and Dye Corporation, 61, Broadway, New York, 6, N.Y., USA.

Precision castings and in particular those methods for making them, using rigid, self-supporting, resin-bound sand moulds of high permeability and high finish. A wet moulding mixture is formed of a finely-divided refractory material together with an aqueous-dispersion or solution of a water-dispersible or soluble heat-hardenable binder. This is packed into a moulding cavity defined between a pattern (defining at least two of the inner, complementary metal-contacting surfaces of the mould) and a dried support adapted to shape the outer surfaces of the mould. The resultant green-sand mould is hardened in contact with the drier support and metal is cast within the mould thus formed.

765,983. Huttenwerke Phoenix A.G., Phonix-strasse, 7, Duisborg-Ruhrort, Germany.

A method of smelting phosphorus-containing manganese-ore in a blast furnace in which a charge containing the ore is reduced under a slag. This slag contains CaO, MgO, and SiO_2. The ratio of CaO + MgO : SiO_2 is from 1.7 to 2.8, and the MgO content of the slag is greater than 3 per cent.

766,045. Philips Electrical Industries Limited, Spencer House, South Place, Finsbury, London, E.C.2.

The manufacture of permanent magnets. The invention is limited to concern magnetically anistropic magnets of iron-base alloys containing nickel, aluminium and cobalt. The crystals of the alloys are predominantly orientated such that the (100) direction is substantially parallel to the preferred magnetic direction in which the magnet is magnetized. The heat dissipation on the surface situated between the two pole faces is retarded during solidification of the alloy, at least one, preferably both pole faces being cooled. (See also No. 766,046.)

766,060 and **766,061.** United Kingdom Atomic Energy Authority, London.

766,060. Uranium alloys containing from 0.2 to 10 per cent. by weight of molybdenum. The balance (apart from impurities) is uranium. 766,061. An alloy of uranium containing from 0.1 to 5 per cent. of molybdenum and from 0.1 to 5 per cent. by weight of silicon. The balance (apart from impurities) is uranium

766,065. Catalin Limited, Farm Hill Road, Waltham Abbey, Essex; M. Apley, 80, Chase Road, London, N.14, and W. F. Martin, 7, Bullsmoor Gardens, Waltham Cross, Herts.

An improved process of treating moulds made from foundry sand for the casting of metals. After the removal of the pattern but prior to pouring, a coating and/or impregnation agent is deposited on and/or in the metal contacting surfaces of the mould. The liquid is then eliminated by volatization and/or combustion. The coating or impregnating agent consists of a natural or synthetic non-heat convertible resin or a mixture of such resins, such as Novolak or oxidized resin (or a mixture of the two), in the form of a solution or dispersion in a volatile and/or combustible organic liquid such as ethyl acetate or isopropanol.

Law Cases

Stanton Ironworks Summoned

The difference between buying and paying was emphasized at Ilkeston Magistrates' Court when the Stanton Ironworks Company, Limited, was summoned on 17 counts, mainly alleging that scrap iron had been bought at prices above the Board of Trade's fixed price. The case was sent for trial at Derbyshire Quarter Sessions on April 3.

Mr. Victor Durand, prosecuting for the Board of Trade, said that the company consumed huge quantities of scrap, and because of its difficulties had paid a price very much above the stipulated 163s. 10d. a ton. The 17 deliveries involved amounted to 113 tons and they were paid for at £85 above the permitted price. The scrap was broken up gas cookers. To establish their case, Ministry officials had gone through 10,000 invoices and seen the company over and over again.

Mr. Frederick Wilkinson, Board of Trade senior inspector, said that he saw Stanton's chief buyer, Mr. L. Clarke, and told him he had reason to believe the company had been buying scrap gas cookers above the stipulated price. Mr. Clarke refused to listen, and said that the company had never bought scrap above the legal price.

Mr. Wilkinson said that the company's managing director, Sir Frederick Scopes, had arranged for him to examine 10,000 invoices covering supplies from July, 1955, to 1956, and the company had placed no difficulties in his way.

Mr. Charles Gruggings, of Loughborough, a director of the Johnson Metal Company, Limited, said that between June, 1955, and January, 1956, his firm bought cast-iron scrap cookers from the East Midland Gas Board and sold them to R. Roberts & Company, Limited, of Long Eaton, who he knew was reselling to Stanton Ironworks.

Mr. Ralph Roberts, of R. Roberts & Company, who supplied the scrap agreed that he made out invoices to Stanton charging for machinery cast scrap—the top grade. He had bought the material as heavy cast scrap and upgraded it himself: "I did not upgrade it off my own bat, but by arrangement with somebody at Stanton whom I do not know," he said, adding that the company never queried the quality of scrap delivered.

Mr. Mervyn Griffith-Jones, defending, asked the court to draw a distinction between "buying and paying." The company had paid the price of the scrap, stated on the invoices and had relied on the honesty of their suppliers he said. The company reserved its defence.

Lack of Gloves Blamed

Before Judge Ralph Shove at Lincoln County Court, Mr. Joseph Wrack Simpson successfully sued the Lincoln engineering firm, Ruston & Hornsby, Limited. Mr. Simpson, who is a crane slinger, was awarded £225 8s. damages in a claim for injuries to his right foot. He was away from work for 16 weeks.

It was stated that Mr. Simpson injured his foot in 1955 when a heavy sand "core" fell on it. He said the core was too hot for him to hold steady with bare hands. Since February, 1954, he had persistently asked for protective gloves, but he was usually told, he said, that he must use some rags.

For the company, Mr. I. Sunderland said that protective gloves could have been obtained by Simpson. He denied that Simpson had repeatedly asked for them.

Origin of Graphite in Cast Irons

By J. E. Harris, B.Sc., and V. Kondic, B.Sc., Ph.D.

(*Continued from page 277*)

In the second part of this survey, the Authors consider their own experimental results in the light of those reported by others working in the same field—and which were briefly quoted in their introductory section. On this basis, a theory for the mechanism of graphite formation in hypo-eutectic cast irons has been put forward. The mechanism assume that, in general, the graphite phase can form in these cast irons through the decomposition of Fe_3C.

COMMENT ON RESULTS

Stability of Fe_3C

If a normal ternary Fe/Si/C hypo-eutectic cast iron is cooled fast enough during solidification, its eutectic will be ledeburitic or white. On reheating this iron, however, the Fe_3C phase of the eutectic decomposes into Feγ* and graphite. Two aspects of such a decomposition have been studied in the present work; (*a*) the effects of carbon and silicon contents in iron, and time and temperature, on the kinetics of the decomposition and (*b*) the type of graphite produced by the decomposition.

Two variables that have been found to influence most the speed of decomposition of Fe_3C in this work are: Si and C contents of the white iron and the decomposition temperature. In the text of this Paper, the carbide phase has been designated from the point of view of simplicity as Fe_3C. In fact, it is widely recognized that in grey irons this carbide is much more complex and should be designated as $(FeSi)_3C$. This designation is much nearer to the facts, but is still a simplification, as this carbide is a non-stoichiometric compound.

The most appropriate source from which it is possible to obtain some information regarding the theoretical question of the compositional effects on carbide stability is the field of alloy thermodynamics. The general picture has been recently reviewed by Richardson[16], who showed that (*a*) Fe_3C becomes less stable with an increasing carbon-content, (*b*) the solution effect of Si in Fe is that of lowering the stability of iron carbide at higher temperatures. Unfortunately, as Richardson points out, the thermodynamic data on ternary carbides are incomplete for predicting the exact equilibria at different temperatures.

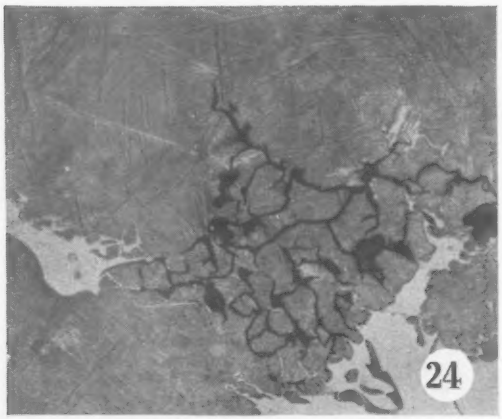
Perhaps the most interesting kinetic information obtained in this work is that the times of decomposition of Fe_3C are rapidly lowered with an increasing temperature, so that near the solidus, the decomposition times for a given iron can be compared with the times of solidification in metal or sand moulds. As the mixed carbide is unstable and decomposes fast enough at temperatures well below the solidus, it is the total time of cooling of a casting during, as well as below, the eutectic arrest that will determine whether any carbide in the eutectic mixture will be obtained at room temperature.

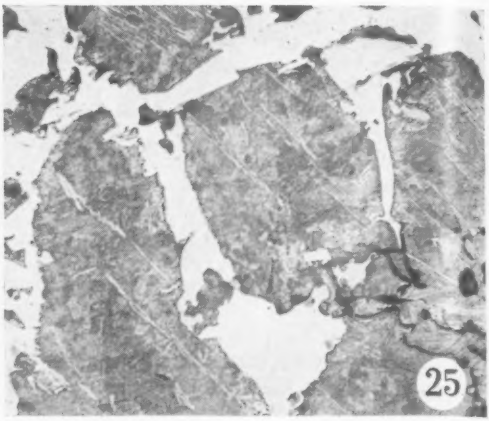
Graphite Produced by the Decomposition of Fe_3C

In the normal process of malleablizing in industry, two distinct types of graphite are recognized; rounded shape (whiteheart) and flake shape or aggregate (blackheart). One of the reasons for such variation in the forms of graphite has been established to be due to the impurities in iron (particularly S, and the way this S is tied up with either Fe or Mn)[14]. However, little information is available in the technical literature, apart from the work of Massari[17], on the effects of high temperature of decomposition on the graphite shapes produced by the malleablizing process.

The evidence which has been obtained in this work shows that most of the graphite shapes and distributions that have been observed to form in hypo-eutectic cast irons during the normal process of solidification can be also produced by the decomposition of the carbide in the solid state. Variables that control the graphite shape, *i.e.*, whether one of the flake or spherical varieties, appears to be primarily the composition of the iron, and particularly the presence of minor alloying elements and secondly the temperature. With the usual S contents encountered in cast irons varying from 0.05 to 0.1 per cent., the graphite produced by the decomposition process is usually in the flake form. In the lower decomposition temperature range, these flakes are compacted into units (aggregates), but with an increasing decomposition temperature the flakes separate, first into "chunky" forms and then at temperatures close to the solidus, into the usual flake type which are observed in grey-iron castings ("A" type). From the point of view of flake-graphite shape and form, it is impossible in some cases to distinguish whether the graphite of an iron sample is that produced by the decomposition on reheating, or by the normal solidification process. A particularly interesting variant of flake-graphite distribution is the eutectiferous, or "undercooled" or "D" type. This form of graphite can be readily obtained in grey-iron castings, and in general it is most frequently found

* In the first section of this paper, printed last week, this expression was shown incorrectly on page 267 as Feδ (delta) instead of Feγ (gamma). Apologies are made to Authors and readers for this error.—EDITOR.





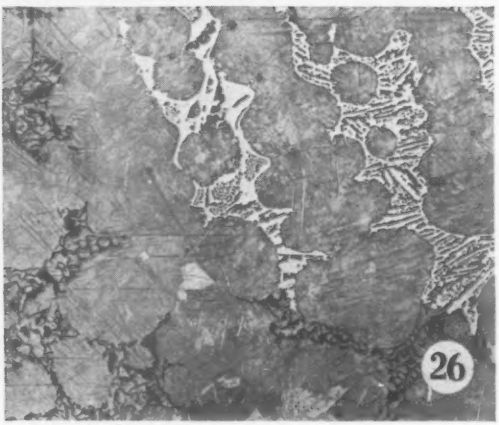


FIG. 24.—*Structure of iron S5 obtained by quenching at the end of the eutectic-arrest,* × 750.

FIG. 25.—*Structure of iron S5 showing both coarse and fine ledeburite obtained by quenching near the end of the eutectic-arrest,* × 750.

FIG. 26.—*Structure of iron S5 quenched half-way during the arrest,* × 150.

(all etched)

in mottled structures and in transition zones from mottled to fully-grey structures. On reheating a white-iron sample from room temperature, this "D" distribution of graphite is more difficult to obtain than any other; this is mainly due to the fact that during reheating other forms and distributions of graphite tend to nucleate and form before the correct temperature and conditions for the formation of "D" graphite are attained. Only very rapid methods of reheating which were used in this work, as for example in the stripping; the mould reheating, or in weld tests, this "D" graphite distribution was more readily obtained. Another variable which has an important bearing on the shape, and particularly on the distribution, of graphite is that of the type of ledeburitic eutectic itself from which the grey structure results. It is not always possible for the coarse ledeburite eutectic to be retained at room temperature, as slow rates of solidification required in this case will normally lead to an immediate decomposition of ledeburite at the same time, however both coarse and fine ledeburite can be obtained in the same sample as shown in Figs. 24 and 25.

The second important form of graphite, the spheroidal or nodular, appears to be controlled primarily by the composition of the iron and secondly by the temperature of its formation. If the composition of the iron is suitable, notably with respect to the minor alloying elements and impurities, then the graphite formed by the decomposition of Fe_3C is rounded or nodular at all temperatures of decomposition. The size and number of nodules varies both with the composition of the iron and the temperature of the decomposition treatment. With some iron compositions it is possible to obtain nodular graphite at some, but not all, temperatures of formation; in addition, depending on the original type of ledeburite, and decomposition temperature, with some iron compositions it is possible to obtain eutectiferous or "D" type of distribution of nodules, Fig. 20, akin to the flake type of "D" structure. Therefore it appears that with the nodular form of graphite also most of the structures that can be produced by direct solidification can also be produced by decomposition of the carbide in the solid state.

Process of Solidification of Hypo-eutectic Grey Cast Irons

Graphite formation. The point has been made in the review part of this Paper that two main schools of thought are held at present on the subject of the origin of flake-type graphite in the structure of a hypo-eutectoid grey iron in the "as-cast" state. According to the direct theory, the graphite flakes form directly from the melt—by the process of nucleation and growth—akin to the formation of any other solid phase during solidification. The indirect theory on the other hand,

assumes that the eutectic which forms first is ledeburitic and that this ledeburite subsequently decomposes, giving the usual grey cast-iron structure. According to the direct theory, the nodular form of graphite forms either indirectly, from the supersaturation of carbon in austenite or directly from the eutectic liquid supersaturated in carbon.[7, 11, 18] In this latter case, nodules form presumably directly from the liquid whilst in the former case they grow in an austenite envelope, by diffusion. The indirect theory does not assume any basic differences between flakes and nodules, in either case, the carbide phase precedes the graphite phase during solidification.

In that part of this Paper which deals with the quench tests, a general hypothesis has been made to explain the origin of graphite in the cast structure of hypo-eutectic grey irons, by the indirect mechanism. It is of interest, now, to examine and contrast the relevant arguments and evidence for both direct and indirect mechanisms of the formation of graphite.

Arguments and Evidence

The basic experiment in support of the direct mechanism is that of quenching. The most recent work in this field is that of Hultgren and his co-workers[5]. They claim that evidence is provided in their work, that the eutectic which has solidified prior to the quench is already grey at the time of the quench, and therefore the graphite formed must have grown directly from the liquid. Such an interpretation of the quenched structure is very hazardous—as it implies that no changes could have taken place in the solid part of the eutectic prior to the quench. From the kinetic data on the stability of carbide at the eutectic temperature, which are given in this Paper, it can be seen that with high C and Si content irons the times of decomposition are so fast that the carbide can readily decompose prior to the quench. It is of particular interest in this connection that many workers who have used the quenching experiments in support of the direct theory have used also high C and Si content irons and do not describe any experiment of quenching samples beyond the end of solidification.

The basic experiments supporting the indirect hypothesis are to be found in the kinetic data and are supported by the quenching and microscopic examinations. The kinetic evidence such as obtained in this work however, can be used only to show that the time of decomposition of carbide in ledeburite can be appreciably shorter than the solidification time of a sample. The question that remains is to show that, in fact, carbide does decompose during the solidification process and that this is the basic mechanism of solidification of hypo-eutectic grey irons. Two experimental observations can be used to show that the decomposition of carbide precedes the formation of graphite. First, the evidence that some residual carbides in the eutectic of a mottled iron can decompose after the end of solidification. This is best demonstrated by selecting suitable iron compositions for which the time of decomposition of carbide is of the same order of magnitude as the solidification times. With an iron whose carbide stability is very much shorter than the solidification times of a sample, on the other hand, it is experimentally difficult and frequently impossible to follow the progress of decomposition as well as that of solidification by the quench method. Secondly, microscopic evidence can be used in support of the indirect mechanism as demonstrated from Figs. 5 (*a*),(*b*), 24, 25, 26, 27, 28 and 29. From Fig. 5 which was taken from the mottled zones of a cast sample, it can be seen that the first regions of graphite encountered in the ledeburitic eutectic are best interpreted as the structure which has formed by an incomplete decomposition process. Some of the microstructures

FIG. 27.—*An iron containing C* 3.2, *Si* 1.84, *and Ti* 0.35 *per cent. quenched just after the beginning of the arrest; etched,* ×150.

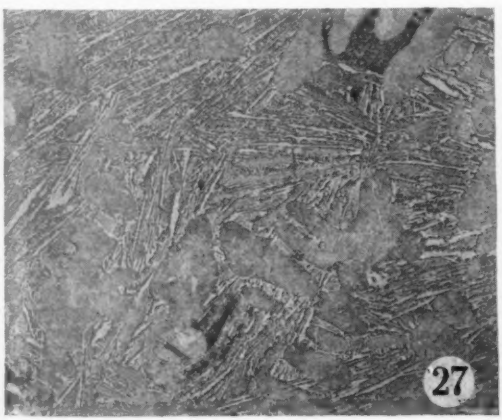


FIG. 28.—*As Fig.* 27, *but quenched half-way during the arrest; etched,* ×600.

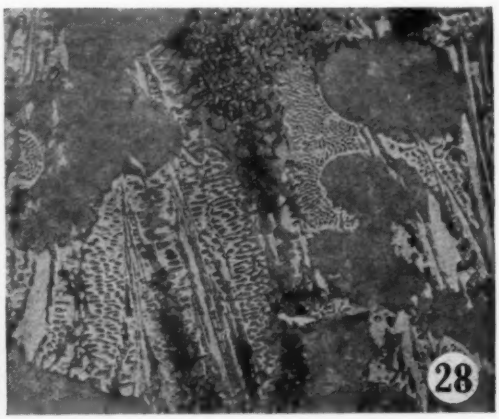


FIG. 29.—*Structure of iron S6 quenched 10 deg. C. below the eutectic-arrest; etched,* × 500.

obtained from the quench experiments, Figs. 26 to 29 are, however, even more conclusive. It is difficult to see how the graphite flakes shown in Figs. 28 and 29 had grown directly from the liquid. Furthermore, the sequence of Fig. 26 to Fig. 29 show gradual stages in decomposition much more conclusively than the gradual stages in the growth from the liquid. It is emphasized that Fig. 26 to Fig. 29 were obtained from samples quenched during, at the end, or past, the eutectic arrest during the solidification process.

General Theory of the Origin of Graphite in Grey Iron

Owing to the compositional complexities as well as phase transformation in the solid state, the cast structure of grey iron is one of the more difficult problems to be explained on a unified theory. There are certain basic characteristics of cast iron which, nevertheless, can be used to test the validity of any such generalized theory. If the origin of graphite is taken as one of the first problems of cast structure, then either the direct or indirect hypothesis of the origin of graphite should be able to explain some, or most, of these general characteristics concerning the observed behaviour of graphite in grey iron. Four metallurigcal characteristics concerning the appearance of graphite in the cast structure of grey iron can be used for a basis of the discussion. These are: (*a*) a decrease in the rate of cooling, for a given cast-iron composition, leads to a change from white to a grey structure, (*b*) with a given rate of cooling, alloying elements (major and minor) may either stabilize white or promote grey cast structure, (*c*) both changes (*a*) and (*b*) are continuous and gradual, so that there is always a set of solidification conditions when both ledeburite and graphite phases coexist and (*d*) most of the graphite phase shapes and distributions that can be produced through the normal solidification process can be also produced by solid-state ledeburite decomposition on reheating.

The chief operating factors of all these characteristics are: composition, temperature, and time. If the direct hypothesis is taken to explain the above characteristics then one must assume, that either by varying the composition or the time/temperature variables, the nucleation and growth habits of different phases change, or that the cooling conditions in the mould change during the solidification so as to replace the appearance of one phase with another. Both of these explanations invoke the principle of discontinuity. Furthermore, neither of these two assumptions can be readily experimentally verified, consequently the direct theory of graphite formation faces formidable obstacles in explaining the basic characteristics concerning the behaviour of graphite in cast irons.

The indirect theory faces no such difficulties, as it is based on two continuously varying phenomena: (*a*) the compositional effects on carbide stability and (*b*) the decomposition rate of carbide as functions of time, during solidification and subsequent cooling. The indirect hypothesis assumes that the eutectic phase of a hypo-eutectic cast-iron begins to solidify as ledeburite. This ledeburite may start to decompose immediately or subsequently (composition, temperature and time variables), and may decompose partly or fully. The types of graphite and its distribution are controlled by the original structure of both primary austenite as well as that of the ledeburitic eutectic and in addition by the nucleation and growth habits of graphite from the ledeburite. The indirect hypothesis does not ignore the two basic phenomena of solidification of metallic liquids, *i.e.*, the processes of nucleation and growth, but assumes that in general the carbide phase nucleates more readily from the liquid than the graphite phase. In the carbon-rich hyper-eutectic alloys, graphite flakes have been observed to float in the liquid (Kish graphite) but this example cannot be extended without experimental evidence to explain a similar mode of nucleation or growth in hypo-eutectic grey irons.

In the field of the metallurgy of cast irons, much more experimental evidence is necessary to finalize all the issues concerning the cast structure of grey iron. For the present, however, the indirect hypothesis provides a much clearer picture of the whole field than was possible with the direct hypothesis. A fully comprehensive theory of all the aspects concerning the state of graphite in cast iron requires much more experimental work.

Acknowledgments

The Authors wish to express their gratitude to the University of Birmingham for the research facilities, to the Department of Scientific and Industrial Research for a research grant, to the British Iron and Steel Research Association for supplying pure iron, and particularly to Mr. H. Morrogh and the British Cast Iron Research Association whose continuous interest and assistance was invaluable.

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Company News

CONSOLIDATED PNEUMATIC TOOL COMPANY, LIMITED—The formation of a Dutch subsidiary—NV Chicago Pneumatic—to carry on the company's business in Holland, is announced. Day-to-day management will temporarily be carried out by Zeevenhooven & Company NV, of Rotterdam.

JACK OLDING & COMPANY (SCOTLAND), LIMITED—The company has purchased and takes over as from March 1 the business of Barclay, Ross & Hutchison, Limited, agricultural and dairy engineers, of Perth. No major changes in the character or structure of the business are contemplated.

AUSTIN & PICKERSGILL, LIMITED, ship builders and repairers, etc., of Sunderland—The offer made on behalf of London & Overseas Freighters, Limited, Lambert Bros., Limited, and Philip Hill, Higginson & Company to purchase the share capital on the basis of 50s. for each £1 ordinary share and 20s. for each £1 preference share has been accepted by holders of 289,019 ordinary (96.3 per cent.) and 293,995 preference shares (98 per cent.).

ALFRED HERBERT, LIMITED—With a final payment of 5 (3¼) per cent., the company is raising its ordinary dividend for the year ended October 31 to 7½ per cent., tax free, from 6 per cent., tax free. However, no special capital dividend is recommended this time against ½ per cent., not subject to tax. Trading profits rose to £3,480,117 from £3,279,540, and, after tax of £1,781,423 (£1,606,886), net profits increased to £1,797,781 from £1,770,583.

COLTNESS IRON COMPANY, LIMITED—The acquisition since the year ended September 30, 1956, of J. & W. Somerville, Limited, involved the realization of a considerable part of investments at a consequential loss. The directors felt that it had in any case to be faced as if a new activity had not been acquired they would have felt obliged to realize the investments which were in excess of trading requirements and to distribute to holders by way of capital repayment.

R. B. PULLIN & COMPANY, LIMITED, gyroscopic engineers and scientific instrument makers, of Brentford (Middx)—The volume of orders on hand ensures a satisfactory level of production for a considerable period ahead and the group's products are of a nature least likely to be affected by cuts in conventional armaments. There is every indication that current and future results of Aldis Bros., Limited (which the company has agreed to acquire), will amply justify the purchase. Progress is being made with the necessary extensions to manufacture under exclusive licence a selected range of the American Kearfott Company's products. It is fully expected to maintain the current rate of dividend—20 per cent. for the year to September 30, 1956—on the ordinary capital as to be increased.

POWER-GAS CORPORATION, LIMITED—During the year ended September 30, 1956, orders received amounted to £12,500,000, well above the average of recent years. Substantial contracts for technical and engineering services were included and, states the chairman, Mr. N. E. Rambush, an increasing volume of similar contracting (which was not affected by the limitation of steel supplies) was anticipated. The outlook for the immediate future was reasonably assured and there was substantial overseas business. The challenge of foreign competition was faced with confidence, but that confidence would be strengthened if steel were more readily obtainable. The group trading profit of £859,714 reflected continuing expansion, but did not signify an increase in profitability of contracts.

Increases in Capital

METAL SUPPLIES, LIMITED, London, S.W.1, increased by £10,000, in £1 shares, beyond the registered capital of £30,000.

BRYANT MACHINERY, LIMITED, Rainham (Essex), increased by £17,400, in £1 ordinary shares, beyond the registered capital of £100.

BRISTOL AERO-ENGINES, LIMITED, Bristol, increased by £3,499,900, in £1 ordinary shares, beyond the registered capital of £100.

CONDER ENGINEERING COMPANY, LIMITED, Winchester, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £10,000.

CONE AUTOMATIC MACHINE COMPANY, LIMITED, Aldridge (Staffs), increased by £100,000, in £1 "B" shares, beyond the registered capital of £250,000.

JOHN LYSAGHT'S SCUNTHORPE WORKS, LIMITED, increased by £1,000,000, in £1 ordinary shares, beyond the registered capital of £6,000,000.

BRIERLEY ENGINEERING COMPANY, LIMITED, Letchworth (Herts), increased by £10,000, in £1 ordinary shares, beyond the registered capital of £10,000.

WHITT & CHAMBERS, LIMITED, engineers, etc., of London, S.W.1, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £10,000.

DOVER ENGINEERING WORKS, LIMITED, Dover, increased by £122,500, in 1,225,000 ordinary shares of 2s., beyond the registered capital of £35,000.

JOHN BROWN LAND BOILERS, LIMITED, London, S.W.1, increased by £500,000, in £1 ordinary shares, beyond the registered capital of £1,000,000.

SMAIL SONS & COMPANY, LIMITED, engineers' furnishers, of Glasgow, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £15,000.

SHEFFIELD VULCANIZING COMPANY, LIMITED, increased by £19,500, in 9,500 ordinary shares and 10,000 unclassified shares of £1, beyond the registered capital of £500.

ARMSTRONG WHITWORTH (METAL INDUSTRIES), LIMITED, Jarrow (Co. Durham), increased by £375,000 in 5s. ordinary shares, beyond the registered capital of £875,000.

ELECTRICAL STEAM & MINING EQUIPMENT (LONDON), LIMITED, Basingstoke (Hants), increased by £15,000, in £1 ordinary shares, beyond the registered capital of £10,000.

W. M. OWLETT & SONS, LIMITED, merchants in iron, steel, and metal ware, etc., of London, E.C.4, increased by £40,000, in £1 shares, beyond the registered capital of £10,000.

ELLIOT BROS. (LONDON), LIMITED, electrical measuring instrument makers, of London, S.E.13, increased by £500,000, in 5s. ordinary shares, beyond the registered capital of £1,500,000.

TRURO ENGINE WORKS, LIMITED, London, W.6, increased by £27,000, in 17,000 6 per cent. non-cumulative preference and 10,000 unclassified shares of £1, beyond the registered capital of £3,000.

SYMONDS ENGINEERING COMPANY, LIMITED, Cheshunt (Herts), increased by £10,000, in 20,000 "A" ordinary shares and 180,000 "B" ordinary shares of 1s. each, beyond the registered capital of £20,000.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

BARNSLEY, March 20—Cast-iron manhole covers and gully gratings for the 12 months ending March 31, 1958, for the Borough Council. The Borough Engineer and Surveyor, Town Hall, Barnsley.

BROWNHILLS, March 9—Cast-iron manhole covers and frames and road gully gratings and frames for the year ending March 31, 1958, for the Urban District Council. Mr. Charles H. Hunt, engineer and surveyor, Coombe House, Brownhills (Staffs).

BURMA, March 13—Nickel-plated pillar cocks and valves, for the Union of Burma Purchase Board. (ESB/4958/57.)

BURMA, March 14—Cast-iron valve gate, for the Union of Burma Purchase Board. (ESB/4968/57.)

EAST RETFORD, March 12—Provision and laying of 5,300 yds. of 4-in. dia. and 5,220 yds. of 3-in. dia. spun-iron water main, for the Rural District Council. John H. Haiste & Partners, consulting engineers, 20, Wood Lane, Headingley, Leeds, 6. (Deposit £3 3s.)

INDIA, March 21—Block distance cast-iron check bolt jaws, for the Director General of Supplies and Disposals. (ESB/4678/57.)

SINGAPORE, March 25—Pipe fittings, for the Singapore City Water Department. (ESB/4794/57.)

URUGUAY, March 20—Iron and steel pipe fittings, for the Administración National de Combustibles Alcohol y Portland. (ESB/4395/57.)

British Blast Furnaces in the December Quarter, 1956

(These tables are published through the courtesy of the British Iron and Steel Federation.)

Derbyshire, Leicestershire, Notts, Northants, and Essex.

Name of firm.	In blast at end of the fourth quarter, 1956.					Weekly average in blast.	Total existing at end of quarter.
	Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.		
Clay Cross Co. (Iron & Foundries)	—	—	1	—	1	1	2
Ford Motor	—	—	1	—	1	1	1
Holwell Iron	—	2	1	—	3	3	4
Kettering Iron & Coal	—	—	2	—	2	2	2
New Cransley Iron & Steel	—	1	—	—	1	1	2
Renishaw Iron	—	—	2	—	2	2	2
Sheepbridge	—	2	—	—	2	2	2
Stanton Ironworks: Stanton-by-Dale	—	—	5	—	5	5	5
Staveley Iron & Chemical	—	—	4	—	4	4	4
Stewarts and Lloyds: Corby	—	4	—	—	4	4	4
Wellingboro' Iron	—	2	—	—	2	2	3
TOTAL	—	11	16	—	27	27	31

Lancashire (excl. N.-W. Coast), Denbighshire, Flintshire, and Cheshire.

Brymbo Steel	—	1	—	—	1	1	1
Darwen & Mostyn	—	—	—	1	1	1	2
Lancashire Steel Corporation	—	2	—	1	3	3	4
Summers, John	—	2	—	—	2	2	2
TOTAL	—	5	—	2	7	7	9

North-West Coast.

Barrow Ironworks	3	—	—	—	3	3	4
Charcoal Iron	—	—	—	—	—	0.2	1
Millom & Askam Hematite Iron	2	—	—	—	2	2	2
United Steel: Workington	2	—	—	1	3	3	3
TOTAL	7	—	—	1	8	8.2	10

Lincolnshire.

Appleby-Frodingham Steel	—	4	—	—	4	3.3	4
Lysaght's Scunthorpe Works	—	3	—	—	3	3	4
Thomas, R., & Baldwins: Redbourne	—	3	—	—	3	2.8	3
TOTAL	—	10	—	—	10	9.1	11

North-East Coast.

Consett Iron	—	3	—	—	3	3	3
Dorman Long (Steel): Acklam	—	2	—	—	2	2	4
Redcar	—	2	—	—	2	2	2
Cleveland	—	—	—	—	—	1.6	4
Bessemer	—	2	—	—	2	2	3
Clay Lane	—	1	—	—	1	0.2	1
Gjers Mills	2	—	—	—	2	2	5
Normanby Iron Works	2	—	—	—	2	2	3
Skinningrove Iron	—	1	—	—	1	1	3
South Durham Steel & Iron:							
West Hartlepool	—	2	—	—	2	2	2
Cargo Fleet	—	2	—	—	2	2	2
TOTAL	4	15	—	—	19	19.8	32

Scotland.

Bairds & Scottish Steel: Gartsherrie	—	2	1	—	3	3	5
Carron	—	—	1	—	1	1	4
Colvilles: Clyde Works	—	3	—	—	3	3	3
Dixon's Ironworks	—	2	—	—	2	2	6
TOTAL	—	7	2	—	9	9	18

South Wales and Monmouthshire.

Briton Ferry Works	1	—	—	—	1	1	1
Guest Keen Iron & Steel: Cardiff	1	2	—	—	3	3	4
Thomas, R., & Baldwins: Ebbw Vale	—	3	—	—	3	3	3
Steel Company of Wales: Margam	—	3	—	—	3	3.3	4
TOTAL	2	8	—	—	10	10.3	12

Foundry Classes

In 1951, the David Dale School, Glasgow, inaugurated day release and evening classes for foundry practice and patternmaking to be held partly at the School, and partly at the Stow College of Engineering, Shamrock Street. The course, which takes five years to complete, is divided into two sections, the students receiving practical training in the school's workshops for the first two years; for the last two years theoretical tuition is also given. It is hoped that shortly the classes will all be held at the David Dale School, where better facilities for both practical and theoretical study are available.

Enrolments for the current session 1956-1957 for foundry practice are the same as for 1955-1956—a total of 18 day release students. A total of 10 apprentices have enrolled for the evening classes as compared with 20 in 1955-1956; it is stated that these enrolments are insufficient to supply the requirements of skilled journeymen for the area. The number of students taking the patternmaking course remains static, this is doubtlessly due to the limited number of apprentices that are employed in the area, at present some 30 students are enrolled for this course.

While full co-operation of the local employers is being given in enabling students to attend the day-release classes in foundry practice, reports to hand, indicate that few young people are prepared to serve their time in the foundry, other occupations proving to be much more attractive.

DSIR Reports

The Technical Information and Documents Unit of the Department of Scientific Research, Cunard Building, 15, Regent Street, London, S.W.1, announces that unpublished reports are available for inspection at the above address, or reports or enlarged photocopies of microfilms may be borrowed without charge. Copies or photocopies for retention may be obtained on request at the prices and in the manner indicated. Payment should not be made at the time of ordering.

Among those of some interest to readers is *Report PB.111807*, covering the major factors in the cathodic protection of steel in sea-water. This incorporates a brief survey of work carried out by the Naval Research Laboratory, a review of existing theories on cathodic protection, and a statement on laboratory and field criteria for assessing the results secured. The significance of current distribution is discussed and a summary of the literature included. (The report costs 5s. 3d. as a microfilm and as an enlarged print 26s. 3d.).

Report PB.118243, which deals with the performance of galvanic anodes for cathodic protection, presents data showing the relative electrical current output of magnesium, aluminium, and zinc anodes connected to a large steel sea-wall. A discussion of the relative merits of high- and low-voltage anodes and some of the factors involved is included. (A microfilm of this report costs 9s. 9d. and an enlarged print 48s. 9d.)

A survey of the literature on corrosion in engine-cooling systems containing aluminium is given in *Report PB.111817* (which costs 7s. 9d. as a microfilm, and 38s. 9d. as an enlarged print). It contains 119 chronologically arranged abstracts covering the period 1926-55. Papers relating to corrosion in aircraft engines and on the railways are included as a guide to problems encountered with marine diesels having aluminium cylinder-blocks.

The effects of range of stress and prestrain on notched specimens of titanium and its alloys are discussed in *Report PB.118379* (Price 10s. 9d. as a microfilm and 53s. 9d. as an enlarged print.)

THE Scottish Council (Development and Industry) has decided to hold the third Scottish Industries Exhibition in Glasgow in 1959.

British Blast Furnaces in the December Quarter, 1956—*continued*

Staffordshire, Shropshire, Worcestershire, and Warwickshire.

Name of firm.	In blast at end of the fourth quarter, 1956.					Weekly average in blast.	Total existing at end of quarter.
	Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.		
Goldendale Iron	—	—	1	—	1	1	2
Lilleshall	—	—	1	—	1	1	2
Round Oak Steel Works	—	—	—	—	—	—	2
Shelton Iron & Steel	—	3	—	—	3	2.6	3
Stewarts and Lloyds : Bilston	—	2	—	—	2	2	3
TOTAL	—	5	2	—	7	6.6	12
Sheffield.							
Park Gate Iron & Steel	—	2	—	—	2	2	2
GRAND TOTAL	13	63	20	3	99	99	137

Weekly Average Number of Furnaces in Blast during the December Quarter, 1956, and the Previous Four Quarters

District.	1955.	1956.			
	Dec.	March.	June.	Sept.	Dec.
Derby, Leics., Notts., Northants and Essex	25.5	25.7	24.9	26.6	27
Lancs. (excl. N.-W. Coast), Denbigh, Flint, and Ches.	6.7	7	7	6.9	7
Lincolnshire	10	10.1	9.5	9.2	9.1
North-East Coast	20.8	21	21	20.2	19.8
Scotland	9	9	9	9	9
Staffs., Shrops., Worcs., and Warwicks	7.2	7	7	7	6.6
S. Wales and Monmouth	9.8	10.8	9.8	9.6	10.3
Sheffield	2	2	2	2	2
North-West Coast	9	9	9	9	8.2
TOTAL	100	101.6	99.2	99.5	99

The following companies have furnaces in course of construction or rebuilding:—Dorman Long (Steel); South Durham Steel & Iron (West Hartlepool and Cargo Fleet); Millom & Askam Hematite Iron; Colvilles.

Precautions Against Anthrax Inquiry

The first full-scale inquiry for the last 40 years is to be made into the question of precautions against anthrax. This was announced last week in the House of Commons by Mr. Iain Macleod, Minister of Labour and National Service, who said that he proposed to set up a Committee of Inquiry with the following terms of reference :—"To consider the existing legal provisions concerning the importation of goods infected or likely to be infected with anthrax and the precautions to be taken in connection with such imported goods for the protection of the health of persons and to make recommendations." Mr. R. F. Levy, Q.C., has agreed to act as chairman of the Committee. The names of the other members will be announced shortly.

The last comprehensive inquiry was made during the 1914-18 war and it is on the recommendations made at that time by the Departmental Committee on Anthrax that present legislation is based. Since then there have been changes in the pattern of trade and developments affecting methods of disinfection as well as in the medical treatment of the disease, and in recent years the Minister has received a number of representations asking for various amendments to be made in the existing legislation. In the earlier inquiry, the importation of straw rope (which, of course, is used extensively by some founders) was included.

Personal

Mr. ANGUS MURRAY, B.SC., has been appointed managing director of the Expert Tool group of companies.

Mr. T. YEO SHERWELL and General Sir WILLIAM PLATT are retiring from the Board of Mather & Platt, Limited, on March 31.

Mr. J. A. LAMOND, B.SC. (ENG.), has been appointed joint managing director of W. H. A. Robertson & Company, Limited, of Bedford.

Mr. A. R. W. LOW, the former Minister of State, Board of Trade, has been appointed a director of the General Electric Company, Limited.

Mr. C. R. JONES has been appointed area manager for Crofts (Engineers) Limited, Bradford, in succession to Mr. Harry Walton, who is retiring after being with the company for 53 years.

Mr. L. K. BRINDLEY, deputy chairman of the Mond Nickel Company, Limited, and of Henry Wiggin & Company, Limited, having reached retirement age, has relinquished his appointments.

Mr. S. C. TYRRELL, assistant managing director in charge of the excavator division of Newton Chambers & Company, Limited, Thorncliffe, has left England for South Africa on a business tour.

Mr. R. TURNER, chief engineer of Powell Duffryn Technical Services, has been appointed to the board of that company in place of Mr. G. W. ALEXANDER, chief engineer of Powell Duffryn.

Mr. GEORGE H. PATTON has resigned from the secretaryship of Harland & Wolff Limited, on account of ill-health. Mr. T. E. MURPHY has been appointed to succeed him as from March 1.

Mr. C. F. J. BROOKE-HARTE, formerly assistant purchase manager of the Ford Motor Company, Limited, has been appointed executive assistant to Mr. C. THACKER, the managing director.

Mr. F. WHITEHEAD has relinquished his appointment as general manager with the Chatwood Milner (Speke) Organization and has been appointed general manager, metal equipment divisions, at Darlaston and Wrexham with Rubery Owen & Company, Limited.

Mr. A. M. SAGE, B.SC., has been appointed manager of the newly-formed development department of the British Electro Metallurgical Company. For a period Mr. Sage will continue to be responsible for the British Iron and Steel Research Association's work on structural steels in a consultative capacity.

Three new chief product engineers have been appointed at the Doncaster works of International Harvester Company of Great Britain Limited. They are Mr. ROGER CLAYPHAN, for medium crawler tractors; Mr. EDGAR HALSTEAD, for engines, and Mr. KENNETH W. GERKE, assisted by Mr. CHARLEY BENGTSSON, on special projects.

Mr. JOHN I. CRABTREE, has retired after 43 years with the Eastman Kodak Company research laboratories, where he was assistant head of the applied photography division. He founded the department when he went to Rochester USA from England, in 1913. He was also in charge of the company's motion-picture film-developing department from 1916-1938.

THE ADMINISTRATORS of the Sir George Beilby Memorial Fund, representing the Institute of Metals, the Royal Institute of Chemistry and the Society of Chemical Industry, have made an award from the Fund for 1956, of one hundred and fifty guineas, to Mr. R. W. KEAR, F.R.I.C., M.INST.F., in recognition of his work on the behaviour of fuel impurities in combustion processes.

Mr. J. E. SITCH, manager of the Smethwick branch of the Ministry of Labour and National Service, retired at the end of last month after 44 years service with the Ministry. Mr. Sitch was the first Ministry of Labour Employment Exchange manager in the country to inaugurate regular meetings with personnel managers in his area. He is succeeded at Smethwick by Mr. MUNRO, at present manager of the Willenhall (Staffs) branch.

THE LORD MAYOR OF GEELONG, AUSTRALIA, Councillor A. L. Backwell, J.P., has accepted from the Corporation of London a gift of a gavel and stand made from the roof beams of the war-damaged Guildhall. Mr. Backwell asked for them five years ago during a visit to London because Geelong's charter is linked by legislation with the City. The Lord Mayor is a prominent foundry owner in Australia, his business having been established over a hundred years ago, originally as that of ships' chandler.

Griffin & George, Limited, the laboratory furnishers, announce that Mr. RONALD MCKINNON WOOD has asked to be relieved of his duties as chairman of the company in view of the public duties he will assume in the near future as chairman of London County Council. Mr. H. R. BETTINSON, hitherto vice-chairman, will, for the time being, act as chairman of the board, Mr. NORMAN MCKINNON WOOD, relinquishes his appointment as managing director and becomes vice-chairman, and Mr. NORMAN TREPTE has been appointed managing director.

Mr. T. B. HARVEY, managing director of Grangemouth Dockyard Company, Limited, has received presentations on the occasion of his retirement from the board after 37 years' service with the company. He joined the company in 1919 after education at Fettes College and the Royal Technical College, Glasgow, where he studied naval architecture. He is an associate of the Institution of Naval Architects. Mr. A. Aikman, chairman of the company, made the presentation on behalf of the directors and Mr. K. Speirs the presentation on behalf of the staff.

Mr. E. ASBURY and the Birmingham firm, Asbury Brodie & Company, Limited, of which he is chairman and managing director, have recently celebrated two anniversaries. Mr. Asbury has completed 50 years' association with the metal, notably the nickel, industry. During the first 25 years he was a director and sales manager of Henry Wiggin & Company, Limited, and also closely connected with the Mond Nickel Company, Limited, and the International Nickel, Company. Asbury Brodie & Company, Limited, has just completed 25 years of existence. A silver jubilee luncheon was held in February.

Obituary

The death occurred last Friday of Mr. ALBERT EDWARD GRIFFITHS, chairman of Modern Furnaces and Stoves, Limited.

Mr. HOWARD CLAYTON HILL, formerly steelfoundry manager of the East Hecla Works of Hadfields Limited, Sheffield, for 35 years, died on February 25 at the age of 77.

Raw Material Markets

Iron and Steel

The demand for basic steelmaking pig-iron continues to be heavy, and the reduction in imports of scrap has increased pressure from the steelworks on the blast furnaces for supplies of pig-iron, particularly in some areas where the shortage of materials is having a retarding effect on steel output. Reliance has still to be placed on delivery of imported iron to provide additional tonnages for the melting furnaces and, based on the present consumption of the steelworks and the extra tonnages required to meet their programmes for increased outputs of ingot steel, it will be some time before home supplies are sufficient fully to satisfy their requirements of pig-iron, particularly in view of the uncertain and fluctuating supply of scrap.

Deliveries of iron ore to the blast furnaces are maintained at a satisfactory level, although an improved quantity of hematite and low-phosphorus ores is desired by the makers of these grades of pig-iron. Blast-furnace coke is coming forward in sufficient quantities to burden the furnaces. In the ironfoundry trades, the supply of all grades of pig-iron keeps abreast of demand. High-duty castings for many trades are in heaviest demand. Most of the engineering and speciality foundries (apart from those catering for the motor vehicle trade) are taking up good tonnages of hematite and low-phosphorus iron. Although the pressure from the motor vehicle trade for castings continues on a much reduced scale, resulting in a corresponding reduction in the use of pig-iron, makers of hematite and low-phosphorus irons are able to dispose readily of most of their makes and stocks are not high.

The supply of high-phosphorus pig-iron appears to be easier than for some time and the foundries using this grade are able to obtain their requirements readily, apart from high-silicon irons, which are only rarely produced. Some of the engineering foundries, as well as the jobbing foundries, are taking up good tonnages, but most of the light foundries and the textile foundries have insufficient orders on hand to enable them to step up their present moderate demands.

Most of the re-rollers are well employed, but pressure from home users has fallen for some of their products. The major portion of their output continues to be sent to home consumers and stockists, and although some export business is on hand, the tonnages which can be sent overseas are limited. The heavy demand continues for small rounds for reinforcing work.

In some areas pressure is sustained on home steelworks for additional tonnages of steel semis. Stocks at the re-rollers are being used up rapidly and reliance for supplies is confined mainly to English and Welsh sources. Some consignments are still being received from abroad, but on a much reduced scale. While many sizes and grades are in demand, the most sustained is for small billets, particularly 2 in., and for carbon and special quality steels.

Non-ferrous Metals

Although trading activity in the non-ferrous metals is no more than routine on either side of the Atlantic, prices are showing a marked resistance to sinking to lower levels. A week or so ago the steady slide in the LME copper price foreshadowed a lowering of the price below the £240 a ton level, but although there has been no "bullish" news, opinion is hardening that the quotation will begin to edge upwards. This better outlook stems from the improvement in the Middle East situation; the better oil supply position; the prediction by the Congressional Joint Economic Committee that the US economy would reach a new high this year; and finally, that the automobile industry will stage a revival in the second quarter of this year.

In America, primary producers are quoting 32 cents and custom smelters are selling metal at around 31 cents. Export business is being conducted at 30 cents, while the price of scrap remains below 25 cents and above 24 cents a pound. The feature of the US copper situation is the lack of any news concerning cut-backs in production other than in Chile, which is said to be of a routine nature owing to the seasonal shortage of water. It may well be that there will be no reduction in production, but this must assume a strong revival of demand or the entry of the Government into the market to absorb copper for the stockpile. One favourable item of news is that the Japanese Government has allocated $28,500,000 for the purchase of 16,000 tons of electrolytic copper and alloys, 6,000 tons of blister copper, and 15,000 tons of scrap copper-based alloys. These purchases can be made anywhere in the world.

In tin, the noteworthy trend is the narrowing of the backwardation—a feature which ought to continue as the supply position becomes easier. Demand is good in the East, erratic in London, and quietly steady in the US, where the tinplate industry is fully engaged until the middle of this year.

Lead is fairly steady in London and in New York, where the price remains at 16 cents a pound. Zinc is experiencing a steady demand in London, although freer offerings from the Continent and from Russia are keeping the price soft. In America the weight of buying is still concentrated on "Prime Western" grade at 13½ cents a pound, East St. Louis.

Iron and Steel Institute Meeting

The iron and steel engineers' group of the Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1, announce that a two-day meeting on "Air Pollution in the Iron and Steel Industry" will be held on September 25 and 26 at Church House, Westminster, London, S.W.1. Amongst a preliminary list of the papers that will be presented for discussion are the following:—"Measurement of Dust in Flue Gases," by Dr. R. Jackson, British Coal Utilization Research Association, and R. A. Granville, British Iron and Steel Research Association; "Dynamic Dust and Fume Precipitators, with Special Reference to the Iron and Steel Industry," by F. Wright, Air Control Installations, Limited; "Cleaning of Fume from Arc Furnaces," by A. S. Hipkin, Visco Engineering Company, Limited, and "Comparative Capital Costs of Commercial Air Cleaning Plants for Use in Iron and Steel Works," by R. A. Granville, British Iron and Steel Research Association.

ANOTHER RECORD OUTPUT of pig-iron from the four new blast furnaces at its Scunthorpe works is announced by the Appleby-Frodingham Steel Company (branch of the United Steel Companies, Limited). With the newly enlarged "Queen Mary" furnace back in production, the output totalled 109,220 tons during the four weeks ended February 16, an increase of 7,130 tons on the previous four weeks. The "Queen Mary" furnace produced an extra 4,940 tons.

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

March 6, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £20 1s. 0d.; Birmingham, £19 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £21 18s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £22 2s. 3d.

Scotch Iron.—No. 3 foundry, £23 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £24 6s. 6d.; South Zone, £24 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 14s. 0d.; South Zone, £25 16s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £22 17s. 6d.; Scotland (Scotch iron), Zone S. 1, £23 4s. 0d.; Sheffield, £24 4s. 6d.; Birmingham, £24 12s. 0d.; Wales (Welsh iron), £22 17s. 6d.

Basic Pig-iron.—£19 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £51 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £75 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 12s. 3d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £250 0s. 0d.; 38/40 per cent., £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 12s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 15s. 7d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £96 0s.0d. to £96 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. to 31s. 0d. per unit; over 6 per cent. C, £94 0s. 0d. to £95 10s. 0d., basis 60 per cent. Cr, scale 31s. 0d. per unit; 2 per cent. C,* 2s. 1½d. per lb. Cr.; 1 per cent. C,* 2s. 2d. per lb. Cr; 0.15 per cent. C,* 2s. 2½d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent. Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £82 12s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £30 9s. 0d.; tested, 0.08 to 0.25 per cent. C, £31 9s. 0d.; hard (0.41 to 0.60 per cent. C), £32 10s. 6d.; silico-manganese, £41 0s. 0d.; free-cutting, £34 13s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £38 4s. 6d.; silico-manganese, £41 7s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £36 3s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £37 6s. 0d.; acid, up to 0.25 per cent. C, £40 7s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £39 2s. 0d.; boiler plates (N.-E. Coast), £41 12s. 0d.; floor plates (N.-E. Coast), £40 11s. 0d.; sectional material, N.-E. Coast, £37 11s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in. untested (4-ton lots), £37 18s. 0d.; flats, 5 in. wide and under (4-ton lots), £37 18s. 0d.; hoop and strip, £37 17s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £41 6s. 0d.; black sheets (hand mill), 17/20 g., £52 4s. 6d.; galvanized corrugated sheets, 24 g., £65 9s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £64 13s. 9d.; nickel-chrome, £88 15s. 3d.; nickel-chrome-molybdenum, £100 13s. 9d.

NON-FERROUS METALS

Copper.—Cash, £243 0s. 0d. to £243 5s. 0d.; three months, £241 5s. 0d. to £241 10s. 0d.; settlement, £243 5s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 4½d. per lb.; rods, 274s. 0d. per cwt. basis; 20 s.w.g., 307s. 3d. per cwt.

Tin.—Cash, £764 0s. 0d. to £765 0s. 0d.; three months, £749 0s. 0d. to £750 0s. 0d.; settlement, £765 0s. 0d.

Lead (Refined Pig).—First half March, £113 0s. 0d. to £113 5s. 0d.; first half June, £112 10s. 0d. to £112 15s. 0d.

Zinc.—First half March, £97 10s. 0d. to £97 15s. 0d.; first half June, £95 5s. 0d. to £95 7s. 6d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £129 5s. 0d.; rolled zinc (boiler plates), all English destinations, £127 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £110.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 11½d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 212s. 9d. per cwt.; wire, 2s. 8½d.; rolled metal, 212s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £182; B6 (85/15), —; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), — ; HTB2 (38 tons), — ; HTB3 (48 tons), —.

Gunmetal.—BS1400, LG2 (85/5/5/5), £246; LG3 (86/7/5/2), £256; G1 (88/10/2/½), £298; (88/10/2/1), — .

Phosphor Bronze.—BS1400, PB1 (AID released), £316 per ton.

Phosphor Bronze Strip, etc.—Strip, 293s. 3d. per cwt.; sheets to 10 w.g., 293s. 3d. per cwt.; wire, 4s. 0½d. per lb.; rods, 3s. 4½d.; tubes, 3s. 4½d.; chill cast bars: solids 3s. 4d., cored 3s. 5d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 10¾d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 3½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 2½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £84 10s. 0d. to £84 15s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400). AB1, £265; AB2, £275. Solder, brazing, BS1945, type 8 (50/50), — per lb., type 9 (54/46), — per lb.

* Average 68-70 per cent.

Forthcoming Events

MARCH 11

Institution of Works Managers

Manchester branch:—"Medical Aspects of the Factories Acts," by Sir George Barnett, 6.45 p.m., at the Grand Hotel.

Institute of Metals

Scottish local section:—"Production and Uses of Rarer Metals," by J. C. Chaston, B.SC., PH.D., 6.30 p.m., at the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2.

Institution of Production Engineers

Yorkshire section:—"Lubrication in all its Aspects," by Capt. G. E. T. Eyston, 7.15 p.m., at the Hotel Metropole, Leeds.

MARCH 11

Institute of British Foundrymen

Lancashire branch:—"Latest Developments in Spheroidal-graphite Iron," by G. L. Harrison, 7 p.m., at the Midland Hotel, Manchester.

MARCH 12 to 13

Birmingham and District Industrial Training Centre

Course for maintenance workers. Details from the secretary, W. G. Appleyard, 21, Steelhouse Lane, Birmingham, 4.

MARCH 13

Institute of British Foundrymen

Burnley section:—Annual general meeting followed by Foundry Brains Trust, 7.30 p.m., at the Accrington College of Further Education, Sandy Lane, Accrington.

National Society of Master Patternmakers

General meeting and talk on "Moulds and Cores by the CO_2 Process." by Mr. A. Talbot, 2.30 p.m., at the Grand Hotel, Leicester.

Manchester Metallurgical Society

"Precision Casting by the Shaw Process," by N. Shaw, 6.30 p.m., at the Manchester Room, Central Library, Manchester.

Institute of Industrial Supervisors

Acton section:—"Safety and the Factory Acts," by Mr. Pye, 6.30 p.m., at the Telegraph Condenser Company, Limited, North Acton, London, W.3.

Institution of Production Engineers

Halifax graduate section:—"Applied Motion Study," by H. Wilkinson, 7.30 p.m., at the White Swan Hotel.

MARCH 14

Institution of Production Engineers

Leicester section:—"Pride in Craftsmanship—To-day's Challenge," by Sir Gordon Russell, C.B.E., 7 p.m., at the Cromwell Room, Grand Hotel.

Institute of Industrial Supervisors

Smethwick section:—"Job Evaluation," by J. W. Morris, 7.30 p.m., at the Chance Technical College.

MARCH 15

Institute of British Foundrymen

Slough section:—Dinner at Slough Estates Club in Mayfair, followed by theatre visit; 6.30 for 7 p.m.

Changes of Name

Among the companies which have recently changed their names are those listed below. The new titles are given in parentheses.

BROCKHOUSE ENGINEERING (SOUTHPORT), LIMITED, Crossens, Southport, Lancs (Brockhouse Engineering, Limited).

SCIENTIFIC AIR CONDITIONING, LIMITED, Henly Park, Normandy, near Guildford, Surrey (Oxy-Catalyst Sales, Limited).

TANAMI GOLD MINING SYNDICATE, LIMITED, ironfounders, etc., of 20, Copthall Avenue, London, E.C.2 (Hailwood Industries, Limited).

AVON CONSTRUCTION (DONCASTER), LIMITED, engineers, etc., of Barnsley Road, Scawsby, Doncaster (J. W. Thompson & Sons, Limited).

LOW PHOSPHORUS
REFINED & CYLINDER
HEMATITE
MALLEABLE
DERBYSHIRE
NORTHAMPTONSHIRE
SWEDISH CHARCOAL

PIG-IRON

WILLIAM JACKS & CO. LTD.
LONDON, E.C.2.
Winchester House, Old Broad Street
London Wall 4774 (6 lines)

FERRO SILICON 12/14%
ALLOYS & BRIQUETTES
N.F. METALS & ALLOYS
LIMESTONE
GANISTER
MOULDING SAND
REFRACTORIES

And at:—

BIRMINGHAM, 2. 39, Corporation St., Midland 3375/6
LIVERPOOL, 2. 13, Rumford St., Central 1558
GLASGOW, C.2. 93, Hope Street, Central 9969

News in Brief

SANDHOLME IRON COMPANY, LIMITED, has had plans approved for the erection of an extension at their works at Todmorden.

DAVID BRIDGE & COMPANY, LIMITED, has had plans prepared to build a two-storey office block at Castleton Ironworks, Rochdale, Lancs.

THE MIDDLESBROUGH BRANCH OFFICE of Honeywell-Brown, Limited, has moved to larger premises at 52 to 60, Fletcher Street, Middlesbrough (telephone: Middlesbrough 44221/3).

MACHINERY AND PLANT, valued at £1,300, is to be presented by Babcock & Wilcox Limited, Renfrew, to Paisley Trades School, new buildings for which are under construction in Renfrew Road.

COCHRANE & SONS, LIMITED, of the Ouse shipbuilding yard at Selby, has work on hand, or on order, totalling 6,020 tons, representing 15 trawlers. Ten of the vessels are for Trawlers Grimsby, Limited.

AN ORDER worth more than £100,000 has been placed with Guy Motors, Limited, of Wolverhampton, by British Road Services. It is for 106 diesel-engined Guy Vixen pantechnicons for Pickford, Limited.

A BRONZE BUST of the late Lord Austin, by Mr. William Bloye, the Birmingham sculptor, is to be placed in the entrance of the new exhibition hall of the Longbridge works of the Austin Motor Company, Limited.

THE EMPLOYEES at the Dronfield agricultural engineering firm of William Lee & Sons resumed full-time working on March 4. Eight weeks ago the employees were put on short time because of a temporary trade recession.

THREE OF THE PRINCIPAL SUBSIDIARY COMPANIES—J. & H. McLaren, Limited; Petters, Limited; and Mirrlees, Bickerton & Day, Limited—of the Brush group of London, will be exhibiting at this year's Leipzig Fair.

FUNDAMENTAL STUDIES of the structural changes in alloy steels will receive a further impetus as a result of the installation of a Siemens II electron microscope at the central-research department of the United Steel Companies, Limited.

THE SIZE of the shell-moulding night shift at the works of the Phosphor Bronze Company, Limited, Birmingham, is being considerably increased to handle an order for 88,000 castings for a large engineering concern in the North of England.

MINNESOTA MINING & MANUFACTURING COMPANY, LIMITED, Adderley Park, Birmingham, announce that a sanding machine now being produced by Huber of Zurich, called the "Time-saver," would become available in Britain in the near future and negotiations were in progress for their supply here.

RECENT GIFTS received by Glasgow University include an oil engine from Enfield Industrial Engines Limited, Reddich, a moving-field dynamometer from the Macfarlane Engineering Company, Limited, Glasgow, and a special engine supercharger (on permanent loan) from Wellworthy, Limited, Lymington.

FOUNDRY SERVICES, LIMITED, of Nechells, Birmingham, is to manufacture in Japan; a factory is being built at Ashimori near Okayama and will shortly be in operation. Mr. R. A. Miller, sales director, who is soon to pay his third visit to Japan in 12 months, said recently that "there is definite evidence of pro-British feeling in Japan."

ALEX. STEPHEN & SONS, LIMITED, Glasgow, are to build one of the three "Whitby" class anti-submarine frigates which are to be ordered from British shipyards by the South African Government. "Whitby" class frigates are of 2,000 tons standard displacement, and are fitted with geared steam turbines of 30,000 s.h.p., giving a speed of 30 knots.

MR. C. MACQUARIE, general manager of Stewarts and Lloyds, Limited, Bilston, said at the annual presentation of awards on March 1, that a new training centre should be completed next year. There would be a new workshop, drawing office, training laboratory and library. Modernization of plant in the works is also planned, he said, and would include replacement of the old rolling mills.

ONE OF THE LAST REMAINING LINKS with the firm of Warden & Wood, Wolverhampton's first brass foundry, which was established in 1750, will be broken when the proposed new Ring Road pushes its way through the area near St. John's Square, as one of the buildings to disappear will be the premises of Samuel Tonks & Sons, Church Street, a firm of brass founders which took over the business of Warden & Wood.

A PROPOSAL to establish a technical college in Dumfries High School, when that school is wholly accommodated in a new building, partly erected at Marchmount, has been approved by the county education committee. The proposed college is part of a five-year scheme which the committee have in view to meet educational requirements in the county. The total building programme is estimated to cost £1,500,000.

THE SALES OFFICES and order departments of the South-Eastern region of Philips Electrical Limited—previously located at Great Queen Street, W.C.2, 9/15 Oxford Street, W.1, and Century House, Shaftesbury Avenue, W.C.2—were transferred on March 4 to headquarters at:—1 Gerrard Place, London, W.1. (Telephone: GERrard 9941). The new sales depot and trade counter entrance will be situated in Horse and Dolphin Yard, Macclesfield Street, W.1.

TO REMOVE THE OVERBURDEN at their Crosby Warren ironstone quarry in Scunthorpe, the ore mining branch of the United Steel Companies, Limited, are using what is claimed to be the first walking dragline of its size to be manufactured in this country. Known as the W600, the dragline has a maximum capacity of 10 cub. yd. at 184 ft. dumping radius, with a boom length of 186 ft. It weighs 795 tons, and can remove about 400 cub. yd. of spoil per hour, thus enabling an average production of 15,000 tons of ironstone per week to be obtained. Designed and erected on site by Ransomes & Rapier, Limited, the dragline is electrically operated throughout and controlled by Ward-Leonard amplidyne system. The motor generator set and all the motors were supplied by the British Thomson-Houston Company, Limited.

Dr. D. J. URQUHART, senior principal scientific officer of the Department of Scientific and Industrial Research, London, told the annual meeting of the Reference and Special Libraries section of the Yorkshire branch of the Library Association, recently, that the West Riding was in the potential area for siting the projected science and technology library for Britain. He said it would be sited to give a return-post service to industry and commerce in any part of the Kingdom, and would give a double service in helping bibliographical organizations everywhere to know what exists in science and technical literature, and supplying users in daily industry with material not available locally. The library is a project of the DSIR, and the building of its stock will start this year, drawing partly on the resources of the Science Museum Library, South Kensington.